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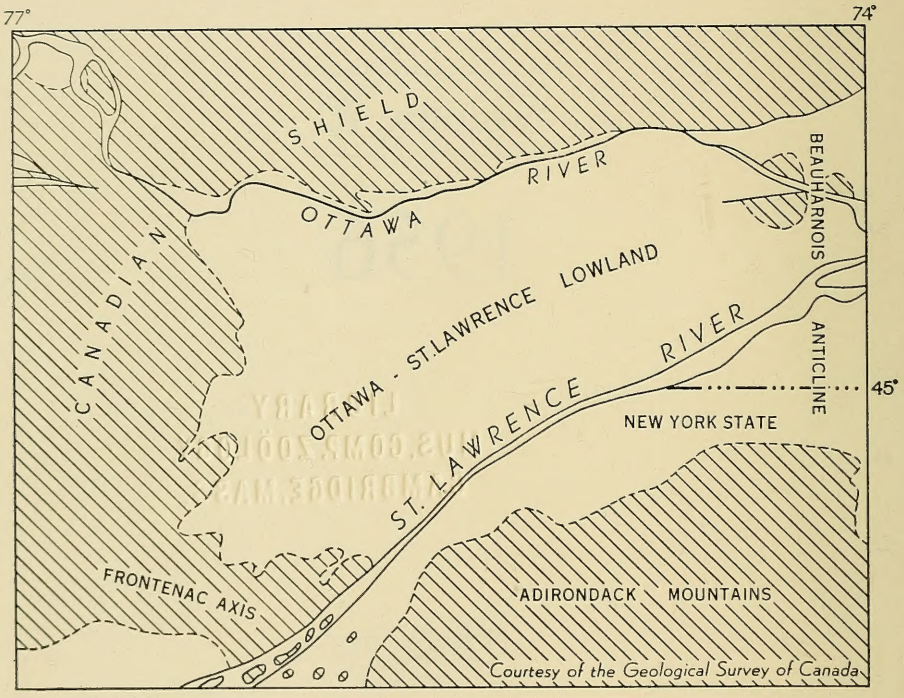
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Ottawa – St. Lawrence Lowland

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A GUIDE

to the

GEOLOGY

of the

OTTAWA DISTRICT

ALICE E. WILSON

A Monograph Issue of

The CANADIAN FIELD-NATURALIST

VOLUME 70 JANUARY-MARCH 1956 NUMBER 1

About the author . . .

Ottawa is the centre of a classical region for geology. Here are displayed, in readily accessible form, representatives of the Precambrian Grenville province, the Ordovician system, and the glacial and postglacial record. Since the time of Logan and Billings, a succession of eminent geologists have found in this vicinity the bases for many valuable contributions to geological science. Alice Evelyn Wilson is a most worthy member of this distinguished company. The greater part of her long and very active career has been devoted to a study of geology in the Ottawa valley.

Dr. Wilson was born in Cobourg, Ontario, and received her B.A. from the University of Toronto. Later she earned a Ph.D. in geology at the University of Chicago. She joined the staff of the Geological Survey of Canada in 1909, and officially retired in 1946. But the latter event had no noticeable effect on the continued production of monographs and contributions. Her numerous publications deal mainly with Ordovician geology and palaeontology, and are culminating in a splendid series of Bulletins on the palaeontology of the Ottawa formation. Dr. Wilson received the decoration Member of the British Empire, in recognition of her contributions to the work of the Geological Survey and National Museum. In 1938 she was made a Fellow of the Royal Society of Canada, the first woman to receive this distinction.

Scientific erudition is not uncommon, but this accompanied by the ability to interpret science to the layman is a rare combination. Dr. Wilson has been very successful in the popular exposition of Ottawa geology, and has been in demand for years as a guide for students and interested amateurs. Since her retirement she has taught geology at Carleton College, and in this work has made the outdoors her laboratory. The Ottawa Field-Naturalists' Club, as well as many other groups, has enjoyed the privilege of exploring the ancient Ordovician sea bottoms under her guidance. To those of us who have had this opportunity it has seemed most desirable that such vast knowledge, and the ability to communicate it, should be combined in a permanent record. With her usual graciousness Dr. Wilson undertook the burden of making this possible. The result is here presented with pride by the Ottawa Field-Naturalists' Club, in the confidence that it will serve many generations of enquiring geologists and naturalists, and will also be an invaluable record of evidence which expanding urbanization may alter or destroy.

LORIS S. RUSSELL
First Vice-President of
The Ottawa Field-Naturalists' Club

The Canadian Field-Naturalist

VOLUME 70 JANUARY-MARCH 1956 NUMBER 1

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A GUIDE TO THE GEOLOGY OF THE OTTAWA DISTRICT

The city of Ottawa, capital of Canada, lies in a lowland walled around by ancient Precambrian rocks (See Frontispiece). On the north rises that part of the great Canadian Shield called 'The Laurentians,' in this region more locally known as the 'Gatineau Hills.' On the south stand the Adirondack Mountains. On the west lies a southward extension of the Shield. South of the Rideau Lakes the main wall turns westward, but a spur, the Frontenac axis, continues to the southeast, forming the Thousand Islands as it crosses the St. Lawrence River. Eventually the spur meets the western flank of the Adirondacks. The eastern boundary of the Lowland, the Beauharnois anticline, is less evident. An anticline (Fig. 1) is the crest of a fold caused by lateral pressure. Extending southward from near St. Jerome, Quebec, the ridge of ancient rocks of the Shield passes beneath some younger sandstone again to emerge as Rigaud Mountain on the west side of the Ottawa River, and as nine small mountains on the east side. Two of those mountains, visible from the canoes of the early voyageurs, gave the name of the Lake of Two Mountains to the broadening of the Ottawa River. Continuing southward the saddle of the ridge is again covered by the younger sandstone and finally connects with the east side of the Adirondack Mountains.

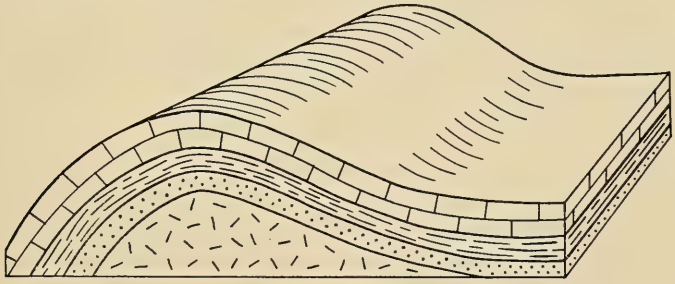


FIG. 1. An anticline

The foundation of our Lowland is composed of the same ancient rocks as the Gatineau Hills, but is overlain by sedimentary deposits: limestones, sandstones, and shales. These sediments are old compared to many in other parts of the world but are much younger than the rocks of the Canadian Shield. For the most part all rocks of the basin are covered by loose, unconsolidated material, but sufficient is exposed on hillsides, in stream channels, and over windswept areas to reveal its past.

The present plant-bearing land of the Ottawa - St. Lawrence Lowland is the result of a long succession of varied events in the Earth's history. Man has partially altered some of the surface of the Lowland, but has not changed it fundamentally. It carries forests, is drained by rivers, and is the home of native birds and animals. But, its long story is still recorded beneath the wooded and farmland covering, and that record covers hundreds of millions of years.

How do we measure such time ? By radio-active residuals. Many of the rocks of the mountains to the north—and what we see in the Laurentians are the roots

of ancient mountains—are cut by veins containing lead and helium gas, the final residue of radio-activity. Expressed in general terms, a radio-active mineral such as uranium gives off rays. When the rays are given off, the material remaining is not quite the same as the original. In time, only lead and helium gas remain. One atom of uranium breaks down into one atom of lead and eight atoms of helium. The rate of disintegration is constant, not affected by heat or pressure. Lead formed by deposition has one atomic weight. Lead formed as a residual from radio-activity has a different atomic weight. Hence it is possible to recognize radio-active residual lead and to calculate the length of time since the vein intruded the host rock from the amount and type of lead remaining. This, however, does not tell the greater age of the rock intruded by the vein.

PART ONE

HISTORY OF THE REGION

Six major events took place in this Lowland: the forming of the Gatineau Hills; a long erosional period; a period of rising and sinking of the Lowland with a corresponding series of invasions of the seas; a second long erosional period; the invasion of the glaciers from the north; and another relatively minor inundation from the ocean—the last to date.

These events were not all of the same order of magnitude. In fact, the far greater effects of the earlier happenings are largely overshadowed by the latter events, the results of which are more evident on the surface.

PRECAMBRIAN ERA

The first event was the forming of the Gatineau Hills in the Precambrian era. The hills are part of what is technically called the Grenville Province of the Canadian Shield. The name comes from the crystalline Grenville limestone, the oldest known rock in the immediate area.

Many things happened in forming those hills. Much of the story has been obliterated but some events can be interpreted. For instance, since limestone is deposited in water, then, before the Grenville limestone was deposited there must have been water over the area, and, because calcium carbonate, the main constituent of limestone, is derived by solution from earlier rocks, there must have been land not far away. On the other hand we know that granite and such rocks were once molten, and crystallized slowly as they cooled far below the surface. Other igneous rocks occur that are called 'basic' or alkaline rocks as opposed to the granites which are more acid in nature. The basic rocks are heavier and darker. They 'freeze' (solidify) from the molten mass at higher temperatures than granites, also far below the surface. Then there are 'metamorphic' rocks. When an area is intruded by molten masses the heat of the magma (the molten mass) causes melting of the original rock where the hot magma comes in contact with the body intruded. Chemical reaction takes place. When all is solidified three types of rock are present: the original type, the intruding mass, and the metamorphic or altered rock, the latter in the areas affected chemically by the heat and pressure.

The Grenville limestone, the oldest known in the basin, has been intruded, overthrust, and it must have been buried for, as mentioned above, all these molten rocks solidify far below the surface. That is, there must have been some, probably a number of prodigious upheavals—mountains upthrust, and probably swallowed again. Great catastrophes!

There is evidence of one or more periods when the area was again part of the surface of the earth. The presence of pillow lavas is definite evidence of a surface period. Lava, unlike acid and basic crystalline rocks, cools quickly when it is ejected into the air or water. Pillow lavas are formed in water like large 'blebs' of hot melted toffee when dropped into cold water. So sometime after the deposition of the Grenville limestone there must again have been surface water and volcanoes somewhere in the area.

Then there are gneisses. Gneisses are crystalline rocks having the long axis of the crystals oriented in one direction, the result of pressure. Some authorities consider them to be sedimentary in origin. If this interpretation is correct, though it is disputed by others, the gneisses, too, would argue for land wearing down.

All this great complex is in turn cut by veins. Some fourteen veins bearing radio-active residuals show ages of more than a thousand million years. How old, then, are the rocks through which they cut!

If these very ancient rocks are evidence of former mountains why do they not vie in height with the Rockies or the Andes? Because they are so very old they have been worn down. During the thousands of millions of years they have been eroded, and lately they have been overridden by glaciers. Now the very roots and core of the mountains lie exposed.

FIRST LONG EROSIONAL INTERVAL

The second event was a long nameless erosional period. The mountains at the north may have been pouring out lavas or otherwise changing the face of the area during the earlier part of the period. In some places over the Shield younger sediments were deposited. Certainly the mountains were being worn down. Always it is so. As soon as mountains are elevated the elements begin their work of erosion. Frost acting on water in cracks breaks up the rock. Water dissolves the solubles. The insolubles crumble and are moved onward by wind and stream. The effects may be slow but they are inevitable.

In your mind place yourself somewhere on a mountain-top not far away, looking across a strange world. No plants! There were no land plants then. Nc animals to be seen! There were no land animals then. Life was in the oceans. Look to the east, if you can see around the earth's curve, and you can in your mind. No Appalachians bar the view to the Atlantic ocean! There were no Appalachians. Look to the west. No Rocky Mountains! There were no Rocky Mountains. Roughly speaking, two great troughs lay just about where those two great mountain systems now stand. During a lowering of the continent the sea entered those two troughs and their subsidiaries. Along the more shallow shores was life. The record stands in the fossils contained in the rocks deposited by the sea waters.

Fossils of this invasion are found in the Maritimes and Newfoundland, and in the sediments of this Cambrian period in the Rocky Mountains. During all these years, some of the mountains here upon which you are standing were high. Our present basin was land. Consequently here the evidence of this long period is

negative. Rock was not deposited but was worn away and distributed elsewhere. Some deep wells in the city of Ottawa penetrate to the Precambrian beneath showing the contact between it and the succeeding sandstone. That contact, in an inch or less, represents 500 to 600 million years! But, this long period is unrepresented. The conditions, causes, and effects of the period must be reconstructed by what took place in other parts of the world during that time, and by the length of time the period lasted.

Sometime, probably near the end of the period of erosion, something happened which resulted in the forming of our basin between the Canadian Shield and the Adirondack Mountains (See Frontispiece). We now call this basin the Ottawa-St. Lawrence Lowland because it is drained by those rivers and their tributaries. On the United States side of the basin, what sedimentary rocks there are, lie in the order in which they were deposited. But on the Canadian side in the north of the basin great disturbances are recorded. The fault line or crack along which the drop took place is clearly seen along the Mountain road continuing north and west from Breckenridge where the ridge stands high above the plain and its outcrops of younger rocks. The same relationship of the Canadian Shield and the younger rocks is very evident farther east on the north side of North River which passes through Lachute, Quebec. It cannot yet be proved that these cracks or faults connect forming one fault or fault zone but what evidence there is strongly supports such continuity. It is more than probable that a slipping of the earth's crust occurred along these cracks more than once.

Why do faults occur?

Take a small handkerchief, about eight inches square. Wrinkle up one half of it into miniature mountains but keep the other half flat maintaining the eight-inch edge. Tension becomes great in the unwrinkled part. It tears. Just so, the earth's crust!

But why does it fall?

As the mountains are pushed up, fold on fold, they leave a space, or at least they would if Nature did not 'abhor' it. In addition, volcanoes eject some of the inner material. Far below molten material from beneath the unfolded area of the crust slowly moves forward to the core of the range. The crust cannot stand the strain. It breaks, then slips down to the space left by the moving material. When the break is vertical or nearly so, the faults are 'normal.' There are also 'horizontal' faults in which the movement is lateral, and within the mountain ranges 'thrust' faults in which part of the crust's surface overrides another part. Most faults in this area are 'normal' faults.

Our Lowland is so covered by loose surface material that lateral movement cannot be traced to any degree, but the vertical movement is recorded by the juxtaposition of two different formations one of which in its original position would be lower than the other.

ORDOVICIAN PERIOD

The third great event took place during the Ordovician period. It was marked by a long period of repeated subsidence and emergence of this part of the continent and the consequent successive invasions and retreats of the ocean into and out of our basin, seven times in all.

BEEKMANTOWN

During the second event, as mentioned above, our basin was high. But slowly the continent was depressed again. During this first invasion the sea spread farther to the west, beyond the Appalachian trough, until it spilled over the Beauharnois anticline on the east into our Lowland formed by the faulting. It advanced over the loose material strewn across the basin during the long erosional period. It dissolved the solubles, and the insoluble sand it deposited all along its westward advancing shore. This sand, now consolidated and known as the Nepean sandstone, did not everywhere cover the sea bottom, particularly in the western part; rather it filled in between the hills of the old Shield which formed the sea floor. In a well at the corner of Somerset and Bay streets the Nepean sandstone is 280 feet thick. In another well on the hill above the Rockcliffe Airport it is 33 feet thick.

But what of the solubles? As time went on and the sea moved still westward they became more and more concentrated and were deposited as a limestone or dolomite—a limestone with some magnesium in it. Just above the Nepean sandstone lie some 25 feet or so of interbedded sandstone and dolomite, the March formation. Finally the sand was all covered, particularly in the eastern part of the Lowland, by some 250 to 325 feet of dolomite, the Oxford formation.

This epoch has been named the Beekmantown, the time of the earliest deposits (in this region) since the Precambrian. In New York State all the sandstone has been considered to belong to the late Cambrian and only the dolomite to the Ordovician period. The reason for considering a Cambrian age was the presence of a small pointed brachiopod, mentioned below. In New York State it was first found in Cambrian rocks only. But, it has since been found in rocks definitely of Ordovician age. That means the form has a range from the Upper Cambrian into the basal Ordovician rocks. In our basin both sandstone and dolomite are included in the Ordovician because the evidence points to a continuous deposition without an erosional break, and unlike the small brachiopod most of the fossils found in the dolomite are limited to the Ordovician.

Between the sandstone and the dolomite is a comparatively thin transitional zone, which was deposited during the process of covering the sandstone. It is considered worthy of a formational name because it is the best water-bearing horizon in the area. The Lower Ordovician rocks, the Beekmantown, then, in this basin consist of three formations, from the base up: the basal sandstone, the Nepean; the transitional zone, the March; the dolomite, the Oxford.

Again the basin was bowed up. The sea drew back over the Beauharnois anticline, where it remained for many long years. How do we know? For one thing the few fossils in these beds, in our area, represent only the lower layers of the whole deposition elsewhere, and the sandstone and dolomite has a maximum thickness of only 350 feet as shown by a well at Carlsbad Springs, whereas in the Montreal area the beds are more than 1000 feet thick. It may be that these dolomites were originally somewhat thicker here and that the uppermost beds were eroded before the next invasion. Nevertheless the conditions show that there was deposition east of the Beauharnois axis long after our Lowland had emerged and before the continent as a whole fully emerged.

This invasion left few fossils in this area. Sand is not a good environment for sustaining life. One or two forms, however, can be found in some localities: a small brachiopod mentioned above, with a pointed beak belonging to the primitive

type in which the two valves move sideways upon one another instead of opening by a hinge structure; and, in the more dolomitic beds some gastropods (snail types).

CHAZY

The second marine invasion of this fluctuating period, the Chazy, also came from the east. The Beauharnois anticline again became a barrier, for the invasion deposited more than 700 feet of rock in the Montreal region before it slopped over the axis into our basin. So, in this basin, we have the top beds of this invasion rather than the basal beds. But, on the other hand, even though deposited near the close of the invasion, these beds are of the basal type, shale and sandstone, because they directly overlie the earlier Beekmantown dolomite after it was exposed to erosion. The sandstone, however, is different from the Nepean. The sea moved over large areas of dolomite deposited during the previous invasion rather than over the deeply eroded Precambrian. As a result shale predominates in most of the area, and the sand occurs in thin layers or in lenses, though in many places it is the more evident of the two because the shale has been more easily eroded later.

Just as in the case of the previous invasion, in time, as shale and sand were being deposited along the western margin the solubles became more and more concentrated and were deposited in the eastern part of the basin, at first being interbedded with some shale, then gradually as purer limestone. The limestone is very thin here and generally mixed with shale. It does not extend far west of Ottawa, but it gradually thickens east of the city. The lower phase of the deposits of the Chazy sea here, the shale and sandstone, have been named the Rockcliffe because of the good exposures there. The upper phase, the limestone, is called the St. Martin formation, because of the good exposures at St. Martin on Isle Jesus, north of Montreal.

There are two characteristic types of brachiopods in these sediments: *Camarotoechia plena*, a pointed form with a distinct fold and sinus and ornamented with fairly coarse striae, and *Hebertella*, a form with a straight hinge line and finer striations than the *Camarotoechia*.

Again the basin was bowed up and the sea disappeared like water off a duck's back. It is probable that this interval was very short, and that the surface was never very much above sea level.

BLACK RIVER - TRENTON

Complementary elevation and subsidence must have occurred elsewhere on the continent because the third invasion came from the southwest over the Frontenac axis (see Frontispiece), and moved eastward over the slightly eroded surface. On the southwest margin of the basin its sediments lie directly upon the Beekmantown dolomite of the first invasion showing that the second inundation never extended as far west as the first.

Moving eastward the third transgression flowed over the preceding deposits, most of which were predominantly limestone or shale, so that the base of the deposits of the third invasion has some shale but only a very few pockets of sandstone. As the basin subsided, thicker and purer limestone was deposited. About 225 to 235 feet above the base the beds again have more shale, probably caused by some shallowing of the basin or some new source of inflow, but again the limestone

content becomes more prevalent. In all some 700 feet of limestone with a little shale testifies to this invasion.

This invasion took place during the Black River - Trenton epoch. These rocks have been divided into seven different beds considered (by some authorities) to be formations or members. Again, there is no sign of a cessation of deposition here. Some change occurs in the fossil content from the bottom to the top, as would be natural during the length of time required to deposit such a thickness in a slowly subsiding basin. The difference in the fauna of the basal and the upper beds is quite evident but the change takes place so gradually as to be almost imperceptible. The interfingering fauna results in a change in the association of forms. It is possible in some cases to point out a difference at the crest, as it were, but the changes in lithology as well as in fauna are so gradual that the dividing lines are purely arbitrary. For these reasons the various phases have been called 'beds' or 'faunal associations' rather than formations or members, but the names have been retained in order to give some idea as to the range of the fossils within the 700 feet.

COLLINGWOOD-GLOUCESTER

Again gradually the basin rose. Slowly it emerged, but not for long; for the succeeding sediments lie conformably upon the limestone beds. If the land had been high and erosion had lasted any length of time the surface of the limestone would have been uneven, or tilted. The contact would not be conformable.

The next invasion, the fourth, was markedly different. It probably came from the east and north. Its sediments extend into New York State, westward along the north shore of Lake Ontario and across to Georgian Bay. There is one small outlier on Lake Clear, not far from Eganville, indicating that it was widespread in Ontario. It also is found on some of the Arctic islands. Concurrently the continent was invaded from the Gulf of Mexico and it may be that the two seas met and mingled for a time.

The nature of its sediments is quite different from any of the preceding ones. They are black in colour. At the base, in this region, lies a thick, black, fine-grained limestone containing large calcite crystals. These layers are interbedded with thin shaly partings. But soon the relationship is reversed. The limestone layers become thinner and thinner and the shale layers thicker and thicker. In some layers these thin limestone bands have become dolomitized. Within about 25 feet the shale has completely eliminated the limestone. From here to the top the deposits are black, easily broken shale. The thickness, including the interbedded shale and limestone and the upper shale, is approximately 250 feet.

The combined shale and interbedded limestone, elsewhere, has been called the Collingwood and the Gloucester formations, the division being within the shale. The combination is here divided differently, the line being placed above the last appearance of the limestone. The basal limestone and its shaly partings, then, is the Eastview and the upper beds, all shale, are the Billings formation. The change is based on lithology and has a practical use for drillers.

These black shales underlie a large area of the city of Ottawa on the south side of a fault extending in a southeasterly direction from the limestone cliff at the heating plant of the Parliament Buildings. The downfaulted section is tilted to the southeast so that the black shales are covered by loose material to an extent of about 50 feet at the corner of Lisgar and Metcalfe streets increasing to between 137 to 138 feet in the Museum grounds. A well at the Veterans' Health Centre on the Smyth Road shows a total thickness of 250 feet.

CARLSBAD

Again the land emerged but again was only slightly above sea level, for there is no trace of erosion between the black shales and the succeeding grey shales. Indeed, it is often hard to distinguish them at the contact, especially when they are wet.

The grey shales are interbedded in places with thin beds of dolomitic limestone. In some cases the dolomitic material is discontinuous or pinched out, as though there was not enough in solution to complete the layer. A well at Carlsbad Springs shows the interbedded grey sediments of this fifth invasion to have a thickness of about 550 feet, but the exposures of it are discouragingly few.

These deposits of grey shales and thin limestones were probably the result of an invasion from the Gulf of Mexico. They occur in New York State and in western Ontario extending north to Georgian Bay, but no trace of this formation has ever been found north of the Ottawa River.

The formation is correlated with the Lorraine of New York State and with the Dundas of the Toronto - Georgian Bay area. A study of the few fossils found in the formation suggests that the lowest beds were not deposited here, and the name Carlsbad has been given to the formation because the best section penetrating them is the deep well at Carlsbad Springs, east of Ottawa.

RUSSELL

Again there was a low elevation of the basin, again followed by a subsidence. It has not yet been possible to estimate the thickness of the next deposit of this sixth invasion, but apparently it is very thin. In mapping the district it has been included with the formation above it. This thin, little exposed formation, the Russell, is all that represents the Meaford formation of the Georgian Bay area.

The sediments, as far as they have been seen, consist of relatively thick beds of grey limestone and rusty weathering dolomitic limestone interbedded with some shale. Only one bona fide outcrop has been seen, barely two feet in thickness, but loose blocks occur in several places. Some of the pieces are replete with fossils, mostly pelecypods (clam type). The formation probably entered as a narrow tongue from the east. Corresponding rocks are found in the Lake St. John area and southwestern Quebec.

QUEENSTON

The next formation lying upon the grey limestone and shale is a red shale with a few green layers, and in places enclosing green nodules.

This deposit of the seventh invasion is considered by some authorities to be delta material. Its rather wide distribution argues against that interpretation. The formation extends in a southerly direction from Georgian Bay across western Ontario to the Niagara Peninsula. It forms the base of the escarpment and takes its name, the Queenston, from this locality. Thence it continues eastward for some distance into New York State. We find it outcropping here and there in Quebec. Another interpretation might be the edge of an epicontinental shelf. The red colour of the shale means oxidation, therefore some exposure, hence the delta or shelf hypotheses. Its exact thickness is not known, but apparently it is very thin.

Another problem arises here. If the red shale is a delta deposit there must have been elevation of the land and a great river. If it is a shelf deposit it would be deposited during an elevation which was the beginning of the second long erosion interval (Fig. 2).

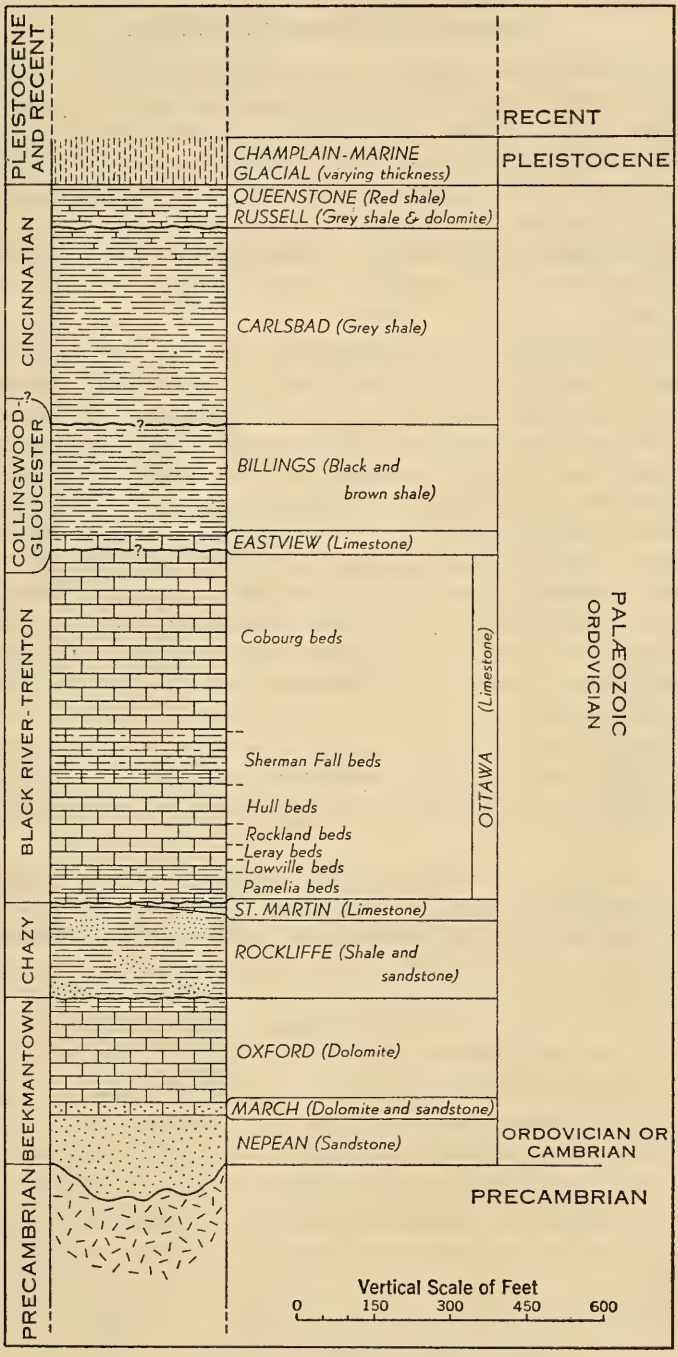


FIG. 2. Ottawa - St. Lawrence Lowland Section

At the Merkley brickyard in Ottawa this shale is used with some clay for making bricks.

SECOND LONG EROSIONAL INTERVAL

The fourth great event! Again the basin was raised above sea level. It slowly rose higher and higher. The second long erosional period was ushered in. It may be that sediments, younger than those described, were deposited here. In western Ontario the red shales were succeeded by all the formations of the Niagara escarpment. If there was a later invasion here all trace of the deposits has been eroded. It is noteworthy, too, that nowhere has any boulder of such been found among the glacial debris although myriads of boulders of the earlier invasions strew the land. Be that as it may, this period of erosion was not without events recorded in other regions.

During the 300 million years or so that the period lasted, the great oil-bearing rocks of Alberta were deposited, as well as those of western Ontario which for more than 100 years have been yielding a steady, though less spectacular, flow of gas and oil. But our basin was land. In the sea, elsewhere, fish became more and more numerous. The primitive ones were covered with protecting shell. Slowly through the ages they lost the shell and developed speed, and finally evolved into the fish as we know them. It was during this time that plants and animals began to take to the land. In the swamps the great coal forests, mostly composed of gigantic ferns, covered large areas. Slowly modern vegetation appeared. The first primitive land animals were not entirely divorced from the sea. Like the frog of today they returned to the water to deposit their eggs. After them came the reptiles, among them the dinosaurs of Alberta. Little mammals began to appear. When the dinosaurs died out the mammals developed apace.

Probably there were plants and animals here but we do not know, for all trace of them was wiped out by the next event. But, nevertheless, we do know that at least one, possibly several, mighty catastrophes altered the whole face of our Lowland.

Sometime during the submergence and emergence which constitutes the third great event of the basin's history the Appalachian Mountains began to rise, at first in the north, extending from the New England states into the Maritime provinces. Then throughout the centuries, including the time of the fourth great event, they rose farther and farther to the south. How did that affect our basin? The strains and stresses of the earth's crust resulted in cracks and then faulting of the sediments. Probably, also, there was renewed movement along old Precambrian faults.

How do we know that faulting took place during this erosion period? Because the red shales, the youngest rocks deposited by the invasions have been faulted down some 1800 to 2000 feet in relation to the rocks on the other side of the fault. That downdrop of the red shales protected them from complete erosion (Fig. 3).

Probably movement took place more than once. Periodically the Appalachians were pushed up, but as the movement progressed southward the effect in this area would diminish.

One of the main faults extends down the Mines road in the Gatineau region. In its hollow lies Fairy Lake. Its effect can be seen in the tilted rocks of the islands around the filtration plant. It crosses Carling Avenue at the Experimental Farm hill and the Morrisburg Road just south of Leitrim, still curving to the southeast.

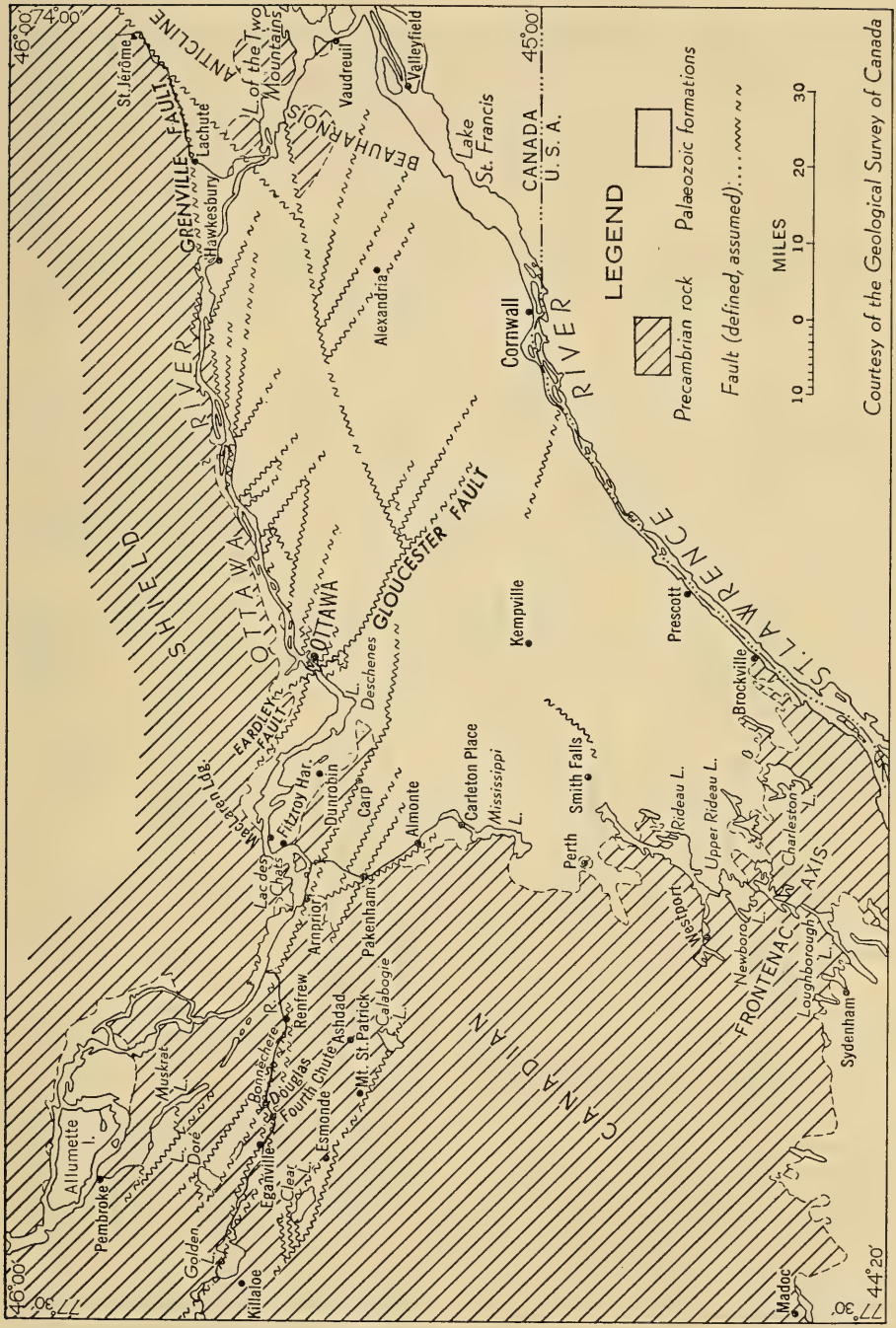


FIG. 3. Structural map of the Ottawa - St. Lawrence Lowland showing faults affecting the Palaeozoic formations

This has been called the Gloucester fault. A little west of Russell village it breaks. A main fault turns to the northeast and its eastern end brings up Rigaud Mountain.

What is the result? The block to the east of the Gloucester fault dropped. That means, as mentioned above, that the main part of the city of Ottawa stands on the northwest corner of the down-dropped block (Fig. 4). But it is not quite so simple as that. If you break a rigid cookie it will not often make a clean break. Pieces will break off the edge. Just that happened when the rigid earth's crust broke. A piece on the western edge of the down-dropped block broke and fell, a little crookedly, between the edge of the block and the main fault, and that piece can be seen. Below the hill at Carling and Bronson avenues is the long splinter that broke from the block. In it lie Dow Lake, the Flats, and the railway yards beneath the Somerset and Wellington street bridges. The northern end of the splinter passes under the river. Climb the hill at the Farm and you are crossing the major fault that caused the trouble.

The north side of this large down-dropped block is more complicated along the Ottawa River. A large number of faults almost parallel one another, oriented in a northwest-southeast direction, resulting in numerous small faulted blocks. Some of the blocks slipped down, others while faulting squeezed up their neighbours. If you had lived then and travelled the Montreal Road you would have had to climb over one block and slip down the other side to the next block which probably would not have been flat but sloping up or down to the succeeding block.

But faulting was not the only process during this long erosional period. Weathering went on and on for several hundreds of millions of years. The jagged edges of the blocks became rounded. Rivers worked out valleys. The land, particularly in the lower levels, would be deep in soil.

Still later during this time the Monteregian hills were formed. Montreal Mountain, the most westerly one of the group, is the core of an old volcano. A line of erupting volcanoes so close at hand would not leave this basin undisturbed. There may well have been further movement along established faults.

Long before the next great event both plants and animals had taken to the land. We have no way of knowing by direct evidence whether any lived here, but the probabilities are that life did exist. Just south of James Bay are some land plants that lived as early as the first fifth of this period.

GLACIATION

And then the glaciers came down from the north — the fifth great event.

What happened to our Gatineau Mountains? Their tops—what was left of them after the long erosion—were gouged off, ground up, and carried southward. What happened to our thick deposits of soil? The soil was carried down into New York State. The mountains we see now, have been decapitated and levelled. Although the deep valleys and heights are still in contrast, yet when you look across the tops you see that they are approximately the same height—a peneplain.

As the glaciers melted they dropped the debris which they had gathered. It is strewn all over our countryside—boulders from the hills and from the younger rocks over which the glaciers passed. Some of it, too, has gone down to New York State. Such boulders are commonly called 'erratics' because they have wandered far from their original position.

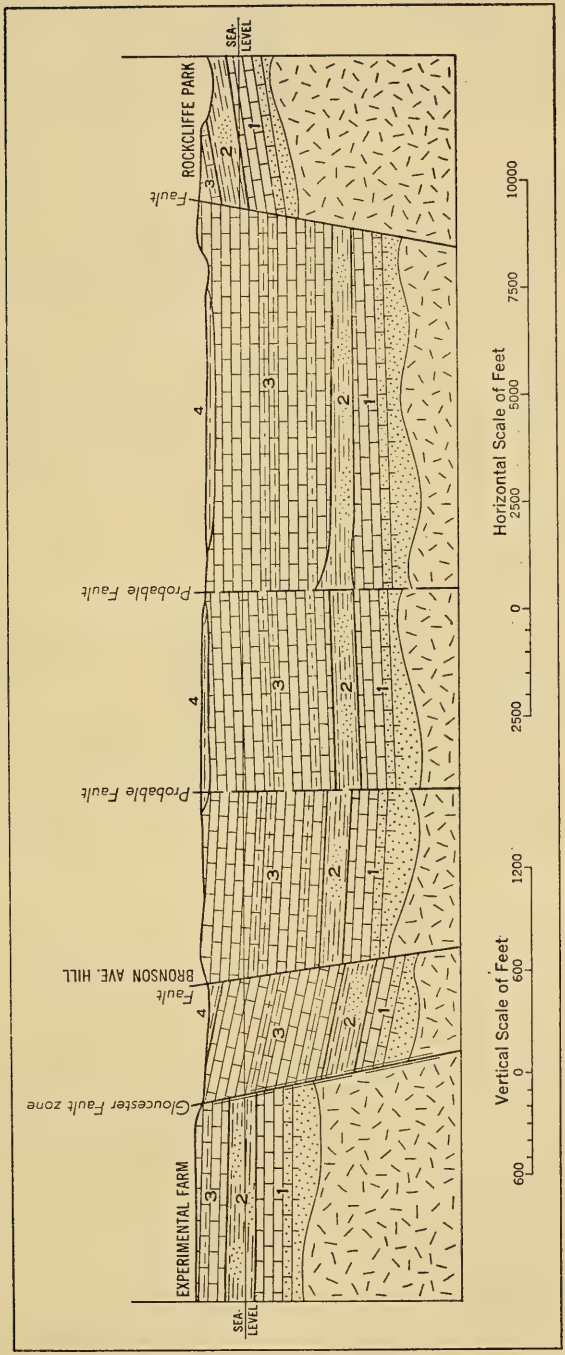


FIG. 4. A vertical slice through the centre of Ottawa from Rockcliffe Park to the Experimental Farm showing the faults that cross it and the relation of the deposits of the sediments of the first four invasions which underlie the heart of the city

Usually the glaciers left a written record of the direction of their movement. The rock base over which they thrust was scratched by the boulders within the ice. In some places where melting water flowed beneath the ice the debris was dropped in long trails. Such trails may be straight or curved according to the course of the under-ice stream. They lie like huge serpents across the country. They may be continuous for a distance or they may be discontinuous due to later erosion. These long mounds are called 'eskers.' There are some, but not many, within this area.

Then there are drumlins, piles of debris shaped like an inverted spoon, broader at one end than at the other. Usually at the centre there is a hard core of rock. Drumlins, too, tell the direction of the ice flow. The moving mass meets an obstacle, now the hard core of the drumlin. As its speed is retarded it divides and piles up some of its debris on the upward end of the obstacle. Moving on along either side it again unites and continues.

An ice-field, static for a time, may deposit debris more or less unevenly from its widespread base forming a ground moraine, or an unmelted block of ice may be surrounded by debris. When the ice is gone an unfilled bowl called a 'kettle' remains, surrounded by debris. The debris piled at the lower edge of the glacier is a 'terminal moraine.' There are also 'lateral moraines' but they are more frequently found in moutainous country piled at the side of a valley glacier.

As the ice cap melted, its margin retreating farther and farther to the north, large freshwater lakes formed along the melting margin. Like all lakes, they too, deposited sediments, and we have heavy clays over large areas of the Lowland. In many places they show the difference between the winter and summer deposition —or what stood for the summer then. Varved or ribbon clays they are called. The summer deposit is thicker and browner because of oxidation.

In time the glaciers disappeared northward but the icefield is not gone. Greenland is still ice-capped as well as some parts of the Arctic islands.

The normal sequence, then, of glacial deposits would be: glacial boulder till overlain by varved clays.

LAST MARINE INVASION

The sixth great event ! This is the shortest chapter in the history of this part of the earth, yet we find its evidence everywhere, even in the gravels that cover many of our roads. The weight of the glaciers depressed the north part of the continent. For, in some places, the ice was a mile thick. When the ice was gone in this eastern part of Canada as well as in the north, the continent was slow to adjust itself. The sea came in once more—the last time to date. It came up the St. Lawrence valley, spread south into the Champlain valley, crossed the Beauharnois axis into our Ottawa - St. Lawrence Lowland. Seashells have been found as far up the Ottawa valley as Pembroke and as far up the St. Lawrence as Brockville. A remnant of seabeach has been reported above the 600-foot elevation on King's Mountain. This does not mean that the Lowland was covered to that height above us but that its floor was later raised to that extent.

The deposits of this Champlain sea, as it is called, are spread in and out among the hills that mark the boundaries of our present Lowland. The tops of the higher hills stood as islands in the sea, just as the Thousand Islands now rise above the St. Lawrence.

As this last sea entered and encountered the debris left by the glaciers and the subsequent glacial lakes it reworked and resorted it, working over the moraines and the finer outwashed material, and re-deposited it anew. In these sediments are the seashells which now we find first in the marine clays, and then in the reworked sands. In the last few years two whales were found in a sand pit near Uplands.

Gradually the earth's crust re-adjusted itself and the sea again withdrew leaving its story behind.

* * *

So now, above the Precambrian complex lies the bedrock of the long-ago deposits of the early period of fluctuating invasions and retreats of the sea, and above that we find the glacial boulder till, the varved clays of the glacial lake deposits and, lastly, the marine clays and sands. In places one or the other may be missing because of some local condition.

And, in two places in the succession of rocks recording the long history of our Lowland is a line where there is nothing. But each line represents the passage of some hundreds of millions of years, the history of which is written elsewhere on the earth.

PART TWO

EXCURSIONS

The logical plan for these field trips would be to visit the outcrops in the order in which they were deposited. This, however, is not always possible because of the limitations of time and space, and because faulting has upset the order in which the sediments are brought to the surface.

In this Part Two the distance between two points is given in order that a long excursion may be split up into two short ones, or conversely that two short ones may be put together, or any other change desired according to the time available or other circumstance.

FIELD TRIP I

THE BRUCITE PLANT

Distance: Ottawa to Brucite Plant via Hull 22 miles.

Arrangements can be made with the company for a conducted tour to see the outcrop in detail. The entrance is on the old Gatineau Road from Farm Point.

The main outcrop is the Grenville limestone or dolomite (p. 5) which contains the almost translucent brucite. Other desiderata to be seen here are various forms of rock metamorphosed by igneous intrusions (p. 4), on the east side of the quarry.

The Grenville limestone can be seen en masse on the east side of the regular Gatineau Road not far south from the east turn to Wakefield. The debris from the quarry forms a gleaming white hill. Here, as in a number of other places, the limestone is quite dolomitic, that is, it has magnesium in it as well as calcium. Bits of the translucent brucite are scattered through the dolomite or are loose in flake-like pieces.

A metamorphic zone (p. 4) on the east side of the glistening hill is shown by the presence of rocks of various colours due to the chemical variations caused by the action of hot intrusives into the Grenville limestone.

NORTH OF CHELSEA

Distance: Brucite Plant to marine clay 10½ miles.

Marine fossils of the Champlain sea (p. 16) occur in the clays on both sides of the highway over the hill just a little north of Chelsea. North of the clay deposit, on the east side of the road, is a pit of sand outwashed and reworked by the same Champlain sea.

GATINEAU PARK

Distance: Chelsea to junction of Kingsmere and Meach Lake roads 1½ miles.

Park cars on the south side of the Kingsmere road just beyond the junction of the Meach Lake road (Fig. 5). Take the first trail north into the bush.

On either side of the trail are outcrops of Grenville limestone intruded by various types of igneous rocks. Many metamorphics (p. 4) are present, also paragneisses and quartzite and such minerals as mica, apatite, quartz, pyroxene crystals and many others.

About a half mile beyond the entrance from the Kingsmere road a mica mine lies some 30 or 40 feet from the trail, on the left.

Farther along the trail on the right are great joint planes weathered to large chasms. The end of the side path is marked by the Parks Branch, and cannot be missed.

Still farther up the trail, on the left side, right at the path is one of the largest erratics (p. 14) to be seen in the area.

Proceeed to the Meadow Picnic Grounds and turn, descending towards the Kingsmere road. At the big curve south of the Grounds is a large basic dike of the gabbro-diorite type. A dike is a mass of igneous rock intruded into a crack of older and usually less resistant rock. The latter weathers more quickly leaving the long, narrow dike extruding like a frozen stream.

KETTLES

Distance: Meach Lake road junction to Meach Lake 3½ miles.

Return to the junction of the Kingsmere road and the Meach Lake road. Drive north on the Meach Lake road to the hill sloping down to the foot of the lake.

To the west of the road just at this corner is a 'kettle' (p. 16), a large hollow that was probably preserved by a block of ice. While the ice was there the glacial debris piled up on either side of it. When the ice melted the hollow or 'kettle' remained surrounded by the debris. The former drainage system issued from the foot of the lake, but was blocked. The old channel can be seen following a low valley connecting with the creek at Old Chelsea. The new drainage begins on the east side of the lake.

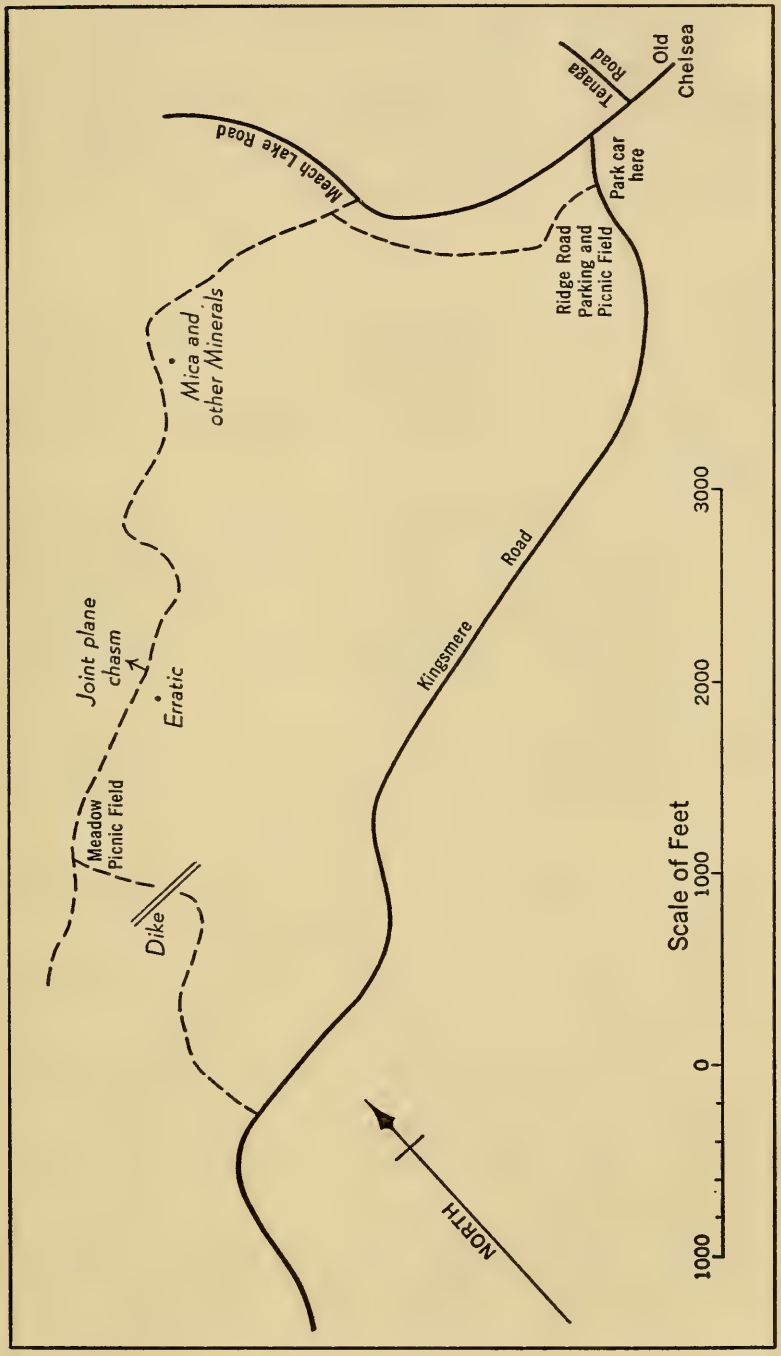


FIG. 5. Ridge Road trail

MAGNETITE MINE

Distance: junction from Kingsmere and Meach Lake roads to Iron Mine 4 miles, to Museum via Driveway 18 miles.

Return south to the Kingsmere road, from thence descend the Mines road. Just after you pass the artificial pond on the right, a wood trail enters the bush on the right. At the edge of the trail just off the road is a cleft in the rock from which magnetic (iron) ore has been taken. Large blocks of the rock, replete with magnetite, are lying all around half buried by the scrub.

FIELD TRIP II

FELDSPAR QUARRY

Distance: Ottawa to Hazeldean 14 miles, to feldspar quarry 2 miles.

At Hazeldean on Highway 15 turn north. Stop at the first crossroad. A quarry lies beyond the fence at the northeast corner. The quarry can also be reached from Highway 17, turning south at the Klondike Inn, South March. The distance is slightly greater.

This quarry is near the end of a Precambrian spur which leaves the Shield at Fitzroy Harbour, projects to the southeast terminating in isolated rocky islands before it passes under the younger sediments a few miles beyond this crossroad (Fig. 6). On the northeast side, the gentle dip of ancient rocks away from the spur has preserved progressively younger rocks in their natural order, extending across the country to a fault near the Mountain road, marking the southern edge of the Shield. The southwest margin of the Precambrian spur is limited by another fault which will be observed later.

Although this Precambrian outcrop has never been thoroughly studied many things of interest can be seen during a short visit.

a) The main body of the rock is a type of hornblende gneiss. It varies considerably from fine to coarse, and from place to place.

b) At the corner just over the fence is a small fault showing the lateral movement of a narrow vein. At some period the vein in a molten state intruded along a crack or a weak plane in the older rock. Later when both country rock and vein were rigid some pressure broke the rock separating the broken ends of the vein.

c) A few steps to the east lies the quarry containing considerable water from springs. A large pegmatite vein is the raison d'être of the quarry. The word pegmatite refers to the granitic nature of the vein and to its large crystals. The sharp contact of this vein and the country rock can be seen on both sides of the quarry. On the north the vein passes beneath the country rock. The main constituents of the vein are pink feldspar, quartzite, and both biotite (dark) and muscovite (light) micas, the latter only in very small quantities. A number of other minerals are present in the country rock itself.

d) Note the relative temperatures at which each constitutent of the vein solidified or 'froze out.' Right at the contact of the vein and the country rock lies the thick, crystalline pink feldspar, in places containing large crystals of dark biotite mica. The mica is not common on the west side of the quarry, but in the piles on the east side flat pieces of large crystals are preserved in the blocks of feldspar. When the vein intruded, as mentioned above, it was molten. The country rock was already solid. The feldspar within the intruding magma (the melted stream) solidi-

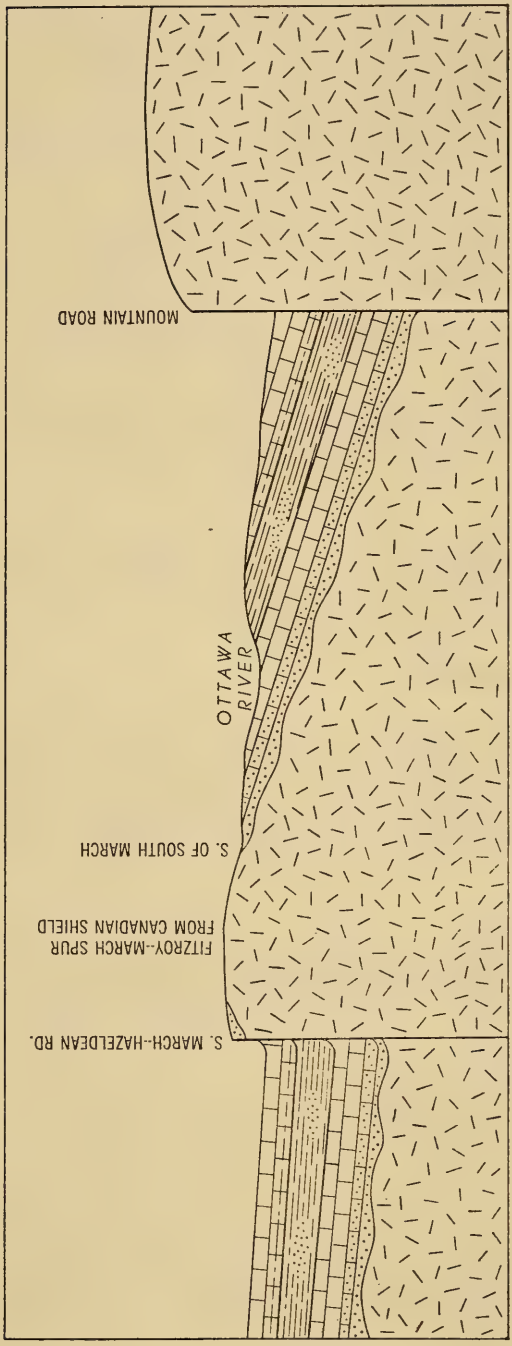


FIG. 6. Cross-section from near Hazeldean to Canadian Shield at Mountain Road

fied first, therefore, the feldspar must have 'frozen' at a higher temperature than the other constituents of the vein.

Next follows an envelope of mixed feldspar and quartzite, also to be seen in blocks on the east side of the quarry. There are variations in the order, probably due to varying temperature within the magma. The regions are not sharply divided.

The last to crystalize is the pure quartzite. Great blocks of it are lying about, again on the east side dump or east of it. When the water is low, just beneath the surface the quartzite core of the vein can be seen at the south end nearest the gate.

e) When the vein in a molten state transgressed a crack in the country rock, why were the edges of that rock not melted? On the quarry side of the pile, on the east side, several sharp-edged pieces of the dark rock are embedded in the feldspar vein. Evidently they were broken and swallowed, but not digested by the intruding molten stream. The reason? A higher temperature than that of the molten magma of the vein would be required to melt the country rock!

A more careful examination, however, shows a slight effect on the lower right hand corner of the dark embedded block. There is a blending. The contact of the hot magma has produced limited chemical action, resulting in a small field of rock different from either of the two original types—metamorphism (p. 4).

f) Another prominent feature of the whole area is the rounded surface of all the rock of the countryside, roche moutonnée (sheep's back), due to the glacial scour.

A great many other conditions and minerals can be found by tramping across, and up and down, the long Precambrian spur.

THE ROAD SOUTH TO HAZELDEAN

a) Driving towards Hazeldean stop just south of the last Precambrian outcrop that extends as a ridge to the east. Look east. Below the ridge across the second field having a 'bush' in the background is a level, or almost level, outcrop of white sandstone just north of the bush between it and the ridge. On the south side of the Precambrian ridge and near it the sandstone can be seen to slope upward against the ridge.

It cannot be established whether the slope of the sandstone adjacent to the ridge is due to a small fault or to slumping of the sand before consolidating. Either interpretation would explain the position. Some of the layers here are quite quartzitic, that is, the sand grains are closely cemented with secondary silica.

That contact represents approximately 500 or 600 million years, the length of time of the first great erosion period (p. 5).

b) Again stop, a little north of the cemetery. On both sides of the road are several outcrops of the sandstone. The Precambrian is covered here. On the west is a drop in the terrain to the rich farm lands at a lower level. Across a narrow field on the west is a clump of trees, most of them felled now, among which lies an outcrop of limestone. In its natural position the limestone should be, roughly speaking, some 450 to 500 feet higher. That drop is due to the fault or crack in the earth's crust along the southwest margin of the Precambrian spur (p. 20). After the faulting the side to the east of the fault must have been a high ridge, now eroded to its present elevation above the down-dropped area. The lower land has caught the rich soil.

CAMPBELL QUARRY

Distance: Hazeldean to Campbell's quarry 3 miles.

A sign on the north side of Highway 15 between Hazeldean and Bell's Corners marks the turn-off to Campbell's quarry. Drive through the fields on the quarry road. Stop beyond the farmhouse and park beyond the barn. This is the first of several Nepean sandstone quarries from which the rock was taken for the Parliament Buildings, Confederation Building, Connaught Building and the Museum. It can be seen also in many smaller buildings throughout the city.

a) A few feet beyond the turn into the quarry on the west side of the quarry and between the trail and the quarry is an artificial ditch in marine clay (p. 17). The clay is rich in Pleistocene fossils. The most prolific is the widespread *Saxicava,* now called *Hiatella.*

Evidently the clay was deposited in a cove in the sandstone hill.

b) In the quarry itself note the direction of the joint planes. Many of them now are outlined by grass streaks. Joint planes occur in rocks because of the shrinkage when the sediments are solidified. On the north end of the quarry where the vertical face of the joint planes is visible they are inclined at quite an angle to the perpendicular.

c) Notice the ripple marks. They are close and mostly asymmetric. The water then must have been shallow. They were probably formed near shore by breaking waves. True wave ripples are symmetric. The water of a wave moves up and down. Only the top water is carried forward by the wind. The resulting ripple is the same on both sides. Current ripple marks, on the other hand, are steeper on the side away from the current, and a breaking wave on a shallow shore is of the nature of a current.

d) Note the 'liesegang'—dark spots of iron material. Percolating water dissolves the oxidized material and carries it through the porous sandstone, redepositing it en route. In some places the dark streaks are shown in irregular concentric circles, in other places the result is suggestive of cross-bedding.

e) Note the occurrence of layers of coarser sand, probably due to some new source of supply or, in some cases, due to sorting by the weight of the larger, heavier grains.

f) About half way up the east side of the quarry is a layer peculiarly marked like a turtle's back. Black patches are separated by low sand riges. It is really a series of mud-cracks, further evidence of shallow water. The source of the mud has been limited, and apparently some of it has been worn off.

Fresh water-mud-cracks curl up with the concave surface uppermost. Mud-cracks from salt water dry, leaving the convex surface uppermost. These are from salt water.

ROAD BACK TO HIGHWAY 15

Stop at the low scarp just south of the farmhouse.

a) Near the base or halfway up the scarp several dirty-looking sandstone layers are interbedded with the dolomite. Nearer the top the sandstone has disappeared. It has been completely covered by dolomite.

Why the intermingling? As the sea moved inland to the west across the basin over the Precambrian base it dissolved the solubles in its path, and deposited the

insoluble sand along its margin. As the shore advanced farther and farther westward the solubles behind it became more and more concentrated and were deposited. Deposition may have been accelerated by bacteria. A layer of dolomite or limestone would be laid. Then a pause until more solutions were concentrated. Meanwhile the sand left was distributed, then more dolomite or limestone. Finally all sand was covered.

b) Note that the dolomite is rusty-weathering because of iron in the water. In places at the top of the low scarp the dolomite has inclusions of large, more or less clear calcite crystals. One explanation for the crystals may be that as the dolomite replaced the limestone there was shrinkage, which is usual in that replacement process. Percolating water has deposited secondary calcite.

c) Near the top of the scarp are some glacial striae in a general northwest-southeast direction. They are not very pronounced, but they indicate the direction of glacial movement in the immediate area.

Driving on still farther towards the Highway on the east side of the quarry road is an abandoned quarry used as a dump. The same features can be seen here, though not so well displayed as on the scarp. A few poorly preserved fossils occur here.

BRITANNIA YACHT CLUB

Distance: Campbell quarry to Yacht Club 7 miles.

At Britannia Heights, just before reaching the traffic lights, turn north from Highway 15 to Highway 17, then again turn north at the little white church. Drive down to the river (Fig. 7). At the sharp turn to the left park the car and take the right trail to the dam and cross the canal.

a) Note the colour and fineness of the sandstone as compared with the Nepean sandstone at the Campbell quarry.

b) Note also the small traces of greenish shale in the hollows of sandstone. No fossils are found here. No self-respecting fossil would live in such an environment.

This outcrop is a large sandstone lens, the result of the second invasion from the east (p. 8). It is only partially typical, and a more characteristic outcrop can be seen on a later excursion.

DUNTILE QUARRY

Distance: Yacht Club to Duntile quarry 4 miles.

The Duntile quarry (Fig. 7) is cut into the hill on the south side of Carling Avenue. The road into it is well marked. The rock of this quarry was deposited by the third invasion that entered the basin over the Frontenac axis (p. 3).

There are several grades of limestone here, and near the base there is more shale interbedded, though it is not always possible to approach the walls because of working conditions. Halfway up the quarry is some fine-grained almost lithographic stone which contains a few fossils. Higher up the rock is a darker grey, and contains many fossils, if you hunt long enough and if the Company has not covered it with debris.

A simple coral, *Streptelasma*, ranges from these beds upward more than 600 feet to the top of the limestone. One characteristic compound coral, *Lyopora halli*, is confined to these upper beds. Brachiopods are also common. Two forms, *Dole-*



FIG. 7. Map for excursions in and around Ottawa

roides pervetus ottawanus and *Hesperorthis tricenaria*, also found here, have a range of approximately only twenty feet. Various species of *Rafinesquina* are most prolific. The genus has a convex pedicle valve and a concave brachial valve. Another form, *Öpikina*, has the same general shape, and is often mistaken for a smaller species of *Rafinesquina*. The most easily distinguished difference lies in the interpunctae on the inner layer of either valve. In *Rafinesquina* the interpunctae are comparatively large and are arranged in rows between the striae. In *Öpikina* the interpunctae form a fine network with no regular arrangement. These two forms are interesting in more than their outward similarity. In these beds the *Öpikina* is more abundant. Gradually upward the numerical ratio changes, and the *Rafinesquina* is more abundant in the upper part of the formation.

Then there are a few large pelecypods (clam type) also a few rather flat gastropods (snail type). Another fairly common group of which there are several species is the cephalopod. The modern squid and the devilfish or octopus, though lacking a shell, are distant relatives even if the relationship is not suggested by the fossil shell. The cephalopods found here are long, straight, cone-shaped creatures divided by partitions into a number of chambers like the living, coiled nautilus.

A few trilobites are present in the rocks, most of them the smooth, less spectacular type. A number of other fossil forms are not so common and are more difficult to distinguish.

KIPPEWA DRIVE

Distance: Duntile quarry to Kippewa Drive 3½ miles.

Turn south at the corner of Carling and Bronson avenues, to Kippewa Drive (Fig. 7). Stop on the slope down to Opeongo Road. On the north side of the Drive is a ledge of grey limestone. It belongs to the same general formation as the rock of the Duntile quarry, but was deposited much later by the same sea. In its natural position it would be roughly 500 feet higher than the rock of that quarry. What happened?

The present Administrative Building at the Experimental Farm was built over an old quarry of approximately the same horizon as the top of the Duntile quarry. This means the outcrop at Kippewa Drive should also be about 500 feet above the Experimental Farm. The answer is that the Carling Avenue hill at the Farm outlines another fault. The Kippewa Drive rock has dropped. In fact, as mentioned previously, the city of Ottawa lies on the northwest corner of a large down-dropped block.

The greatest exposure, of course, of these beds is the cliff all along the Ottawa River within the city. The cliff crosses Rideau Hall grounds meeting the road just east of the gate. It forms the promontory upon which Earnscliffe stands. Lady Grey Drive is cut out of it. It forms Nepean Point and Parliament Hill. Just before Christ Church Cathedral it turns southward and continuing forms the hill on Carling Avenue just west of Bronson Avenue. From here it swings southeast and gradually disappears under the houses on Fourth and Fifth avenues. Before this part of the Glebe was built up a number of very fossiliferous outcrops were exposed in that locality. The whole cliff is due to a curving fault, not the same fault as that crossing the Experimental Farm.

When the large block fell, the block upon which the city stands (p. 14), a piece broke from its western edge and sank still farther. In falling it tilted. Carling

Avenue crosses the broken fragment between the Farm hill and the hill just west of Bronson Avenue. In that fallen strip lie The Flats and the railway yards below the Wellington Street and the Somerset Street bridges. South of Carling Avenue, Dow Lake is part of it (p. 14).

a) At the Kippewa Drive outcrop note the slope of the rock. The edge of the scarp was pulled down by the force of the sinking valley to the west. Excavations for the houses near Opeongo Road and the digging of the sewer exposed black shale, not grey limestone. Other exposures and well drillings show that the black shale was deposited on top of the grey limestone—another proof that the strip has fallen from its high estate.

b) Note the crumbly nature of the rock. Part of that is due to dynamiting for the roadway, but part is due to the breaking along the edges of the fault.

c) Note the calcite in the cracks—a feature often found near a fault. Running water dissolving the limestone flows down the cracks. As it evaporates, or as the calcium becomes concentrated, the water desposits the secondary calcite in a crystalline form.

d) There are a few fossils here, but not many. In the flat weathered exposures such as could be found along the avenues before they were built up, corals were present and numerous brachiopods. It is at this horizon that the replacement of the *Öpikinas* by the *Rafinesquinas* culminates.

HOGSBACK

Distance: Kippewa Drive to Hogsback 3½ miles.

From the Bronson and Carling avenue intersection drive to Preston Street and thence to the Driveway and the Prescott Highway through the Farm to Hogsback.

The name Hogsback (Fig. 8) is given to this outcrop because of the peculiar

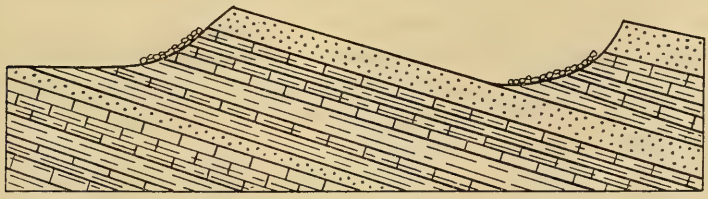


FIG. 8. Typical hogsback (Resistant rock caps and protects weaker underlying rocks)

structure of the rock. Some of it is folded. The small island block that divides the falls is tilted. It is all supposed to resemble a hog's back. The exposure is not quite typical of the form technically called a 'hogsback,' but there is a similarity. Geologically speaking a hogsback is a scarp caused by the dip of the rock from which it is formed.

a) Stand on the bridge facing north towards the falls (Fig. 9).

Compare the rock on either side of the falls. Note the difference in the colour of the layers, and the interbedding on the east side. Why the difference? Again it is due to faulting. The rocks on the east are younger than those on the west. They are down-faulted.

b) Just north of the east end of the bridge a small fault is visible in the wall. Faulting is responsible for the twisted block in the middle of the falls. The block belongs to the rocks on the east. It has broken from the parent rock and was tilted in falling. A fault having a greater displacement separates the block from the rock on the west.

c) Note the long folding of the rock on the north, just at the falls. In falling the edge of the larger down-dropped block has not had room for the movement and has folded somewhat.

d) Visit the rock on the east side of the river. It is limestone with some layers of rusty-weathering dolomite and some shale. This outcrop corresponds to some of the lower layers in the Duntile quarry, a deposition of the third invasion.

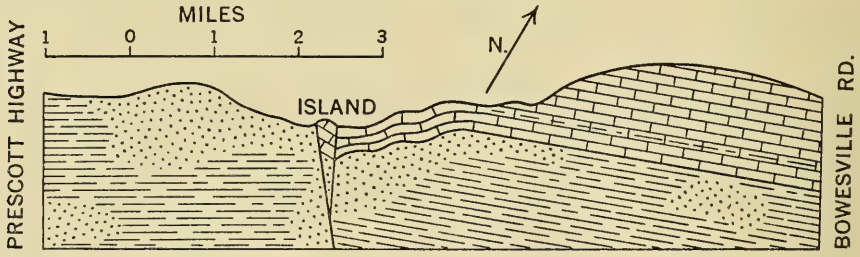


FIG. 9. Hogsback, Ottawa

e) Go down the path on the west and note the type of rock. It is a fine-grained sandstone with some greenish shale in the hollows, a lens of the shale and sandstone of the second invasion, such as was seen at the Yacht Club. It, too, is tilted, and later rounded by weathering. Note that the main slope is in the wrong direction. The rock on the west should be dragged down to the east by the regional down-dropped block but it is the reverse, except for a very narrow edge. Considering this position and the folding mentioned above it looks as though there was some compression at the time of the break.

The whole region around Hogsback is crisscrossed by faults as though the surface had been struck by a mighty hammer in the long ago. The record of a well nearby bears further witness to the broken-up conditions. A fault to be seen later is yet further evidence.

f) Walk east on the road to a path winding northward past one or two houses. On the right of the path is a fenced-off, water-filled quarry. The rock in it corresponds to the top of the Duntile quarry. The elevation of these higher strata is not much greater than the lower beds at the falls because of the eastward dip of the down-dropped block.

g) On either side of the road east from the bridge are two small, abandoned quarries hidden by an overgrowth of bushes and trees. They corroborate the age and the tilting of the beds of the fallen block.

A few fossils can be found here.

h) From the east end of the bridge follow the path south paralleling the river. Another path on the left leads to the entrance of another quarry.

Note the coarse crystalline grain of the rock on the east face of the quarry. This, too, is a deposition of the third invasion, but a part not seen before. It occurs above the Duntile quarry rock and below the rock of Kippewa Drive. It will be

seen again in the large quarries on the Montreal Road in the region known as 'The Quarries.'

On the river side push through the bushes to the west wall. Here the rocks are torn and steeply dipping. The east side of the quarry is down-faulted. The edge of the west side is dragged down with it.

By climbing the rocks in the southwest corner the fault itself can be seen. The actual break is about 12 to 18 inches wide.

For years the only fossils found were bryozoans, a group of very fine colonies. They were carefully studied by an expert in that phylum, but did not yield the age of this twisted wall. During a field trip of the Ottawa Field-Naturalists' Club a participant, hitherto unacquainted with fossils, knocked off a piece of rock containing some brachiopods, *Parastrophia hemiplicata,* which places the beds just above those at the top of the Duntile quarry. The formation is wrongly identified on the map.

WHITE BRIDGE

Distance: Hogsback to White Bridge 1½ miles.

Drive across Hogsback bridge to the Bowesville road. Turn north to the railway track overpass. Park cars and descend to the track, following it to the river. The rock outcrops above and below the bridge, and on the other side of the river.

Watch out for poison ivy here!

a) Note the crystalline nature of the limestone. These are the Hull beds, the same as the coarse grained limestone on the east wall of the quarry south of Hogsback (see above), and the same as the Quarries on the Montreal Road (p. 31).

b) But, the unique feature here is the slope of the beds. Examine the dip under the bridge, then walk upstream along the bank of the river, and note the great increase in the angle of the dip. You are approaching closer and closer to a fault.

The falling piece of the earth's crust pulls down the margin of the rock from which it breaks. In falling, its margin, in turn, is dragged up along the break.

c) Note the large almost black irregular blebs within the rock. They are more evident the farther upstream you go. The black material is chert or flint. Some pieces are not very pure. But try scratching a smooth black piece. Pure chert, like quartz, is very hard.

FIELD TRIP III

ROCKCLIFFE OUTCROPS

Distance: Ottawa, to Rideau Hall gate 5½ miles; to intersection of St. Laurent Blvd. and Montreal Road 10½ miles.

1

Drive to Rockcliffe. Just east of Rideau Hall gate is a rather dark grey limestone ridge, somewhat shattered by dynamiting and by weathering. This is the eastern extremity of the long scarp mentioned in Field Trip II upon which stands the Parliament Buildings and Christ Church Cathedral (p. 26). It is outlined by

a fault which causes the low ground into which the river has penetrated forming Governor's Bay (Fig. 10). The exposure near the gate corresponds approximately to the rocks at Kippewa Drive. It is the top of the deposition of the third invasion (p. 27).

a) Note the dip of the rock, dragged up by the block to the east. The low scarp crosses southeast cutting diagonally through Rideau Hall grounds, and gradually becomes less and less prominent, finally disappearing.

b) A few brachiopods and other fossils can be found here but they are not well preserved.

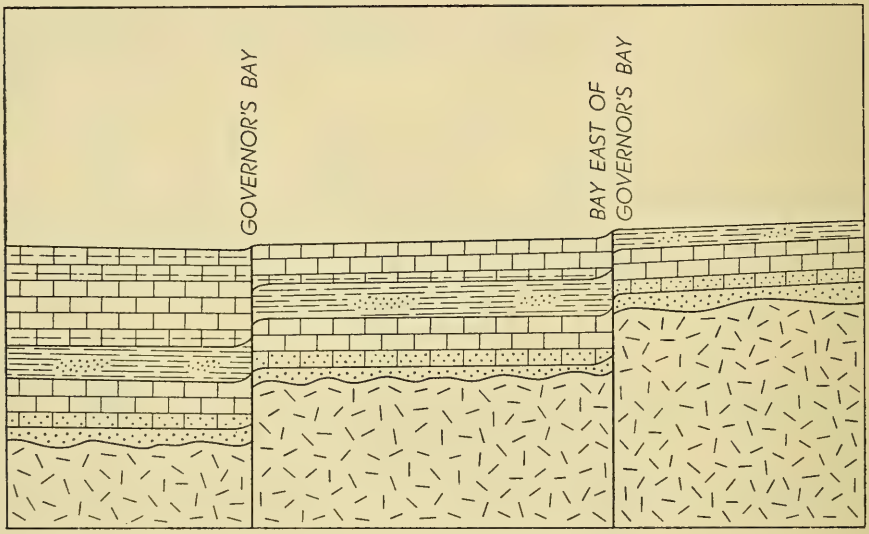


FIG. 10. Section at Rockcliffe Park

2

Drive around to Lookout Point, on the eastern margin of Governor's Bay. Look westward across the bay.

a) The west side of the bay with its promontory upon which Earnscliffe stands has dropped in relation to the rock which forms the Lookout. The small outcrop on the east side of the roadway, in its natural position would be about 450 feet below the rock of the Earnscliffe promontory, or Nepean Point, or Parliament Hill. But, it is about 100 feet higher than the rock at the Duntile quarry, and in texture it is considerably more crystalline.

3

Return to the main Rockcliffe Drive and continue east. Stop before descending the hill to the tennis court.

a) Note the scarp upon which are built the houses above you. The shale is interbedded with thin sandstone layers, almost paper-thin in some places. This is

a deposition of the second invasion (p. 8), and is more characteristic of the whole than the very large sandstone lens seen at the Britannia Yacht Club. As mentioned before (p. 8) the shale in most places is eroded and the more resistant sandstone is preserved. Here, however the shale has been protected by the sandstone layers.

b) The sandstone layers are stringers from a lens which can be seen on the right side of the road descending to the tennis courts, and which is further exposed in the rock garden south of the tennis courts.

MONTREAL ROAD OUTCROPS

Distance: St. Laurent Blvd. to Rockland 20 miles.

1

Return to the Montreal Road via Manor Park and St. Laurent Blvd. Drive east on the Montreal Road. Stop before ascending the slope at the top of which lies the road to the Rockcliffe Airport.

a) In a hollow on the south side of the road a little digging with a hammer will reveal some black-brown shale. It is a part of the same shale found at Billings Bridge (p. 35). The outcrop is poor but significant — a product of the fourth invasion (p. 9).

b) Near the top of the hill on the north side of the road is a small outcrop of crystalline limestone, the same as that exposed at Lookout Point (p. 30), a product of the third invasion, and well down in the strata (p. 8).

c) Note that to the southeast the lowland in which the black shale lies maintains its relative position in the shadow of the older rocks.

2

Drive, or walk back to the northbound road a little west of the Airport road. A little north of the intersection with the Montreal Road is a quarry.

a) Note that the scarp at the quarry and the lowland to the west of it are in the same relative position as the slope and the lowland on the Montreal Road.

b) These features are the result of another northwest-southwest fault. The black shale has dropped several hundred feet from its normal position above the rock of the scarp.

3

Drive east, again, on the Montreal Road. After passing the road leading to the Rockcliffe Airport look to the south.

a) Note the large quarries south of the road. Their outcrop is a continuation of the rock on the scarp. Cross the quarries to the south. The exposure is cut off abruptly by the continuation of the same northwest-southeast fault.

b) Again note the crystalline nature of the limestone. It belongs to the beds exposed on the east side of the road at Lookout Point (p. 30).

Fossils are not numerous in these beds. When they are present they are difficult to extract.

4

Distance: St. Laurent Blvd. to quarry 10½ miles.

Continue on the Montreal Road taking the river road at the fork. Between Orleans and Cumberland is a deep cut in a hill on the south side of the Highway. The rock has evidently been quarried for roadbuilding.

a) Note the rock on the east side of the exposure. It is the same rather fine-grained sandstone as that seen at the Britannia Yacht Club outcrop, and at Rockcliffe before descending to the tennis courts—another lens in the lens-filled shale of the second invasion (p. 8).

b) Note the rock on the right side of the exposure, and on the floor of most of the quarry. It is quite different, a blue-grey dolomite when freshly broken, but weathering rusty. This is the top of the dolomite overlying the basal Nepean sandstone. The base of the dolomite was seen on the low scarp after visiting Campbell's quarry (p. 23).

c) Note that a layer of several feet of sandstone caps the dolomite on the right—a contact between the two formations.

d) Why the juxtaposition of the two formations? There is a relatively small fault here.

Which side is down-dropped? Look on the right side of the outcrop. In its natural position which formation overlies the other? The sandstone. Then the east side, all sandstone, is down-dropped.

e) Now find the general position of the fault on the river side of the road.

RIVER AT ROCKLAND

Distance: St. Laurent Blvd. to Rockland 20 miles.

Continue on the Montreal Road. Turn to the left at Rockland, towards the river. Park near the old Edwards mill. Walk back to the tree-covered bluff on the east side of the road.

a) Note the clear white quartz of a piece freshly broken from the bluff. Some layers are quartzitic, almost solidly cemented. More, however, will crumble into sand. There is some uncertainty as to whether this is a Precambrian quartzite or the basal sandstone seen at the Campbell quarry but differing a little in the more complete cementing of some of the layers. The writer is inclined to the latter interpretation.

b) Cross the swamp to the east of the bluff, or go around it, then proceed a little southward past the sumacs. Here is a quarry of the same old rusty weathering dolomite with patches of secondary calcite crystals, just like that seen on the scarp just south of the Campbell quarry. This outcrop, then, is near the base of the dolomitic phase of the first invasion.

c) Note that the outcrop is considerably lower than the white sandstone bluff, and remember that in its natural position it overlies the sandstone, whether the latter be Nepean sandstone or Precambrian quartzite. In the swamp-filled valley between the two outcrops is the fault that separates them.

STEWART QUARRY, SOUTH OF ROCKLAND

Distance: River at Rockland to Stewart quarry 3 miles.

1

Drive to Highway 17 in Rockland. A little west of this corner turn south on the first continuing road. Go out into the country as far as the sawmill about three-quarters of a mile south of Rockland. Walk east beyond the sawmill into the next field to a small elevation. Descend the north nose of the little bluff.

a) Note the rusty-weathering dolomite at the base, thick-bedded, blue-grey when freshly broken. This, again, is the top of the formation overlying the sandstone seen at the scarp just south of the Campbell quarry (p. 23), at the quarry in the cut on the south side of the Montreal Road between Orleans and Cumberland, and in the down-dropped block near the river at Rockland—the base of the uppermost part of the first invasion (p. 7).

b) About 2 feet higher note the coarse-grained sandstone. This is the base of the deposits of the second invasion (p. 8), one of the larger sandstone lenses at the base of the interbedded shale and sandstone seen at Rockcliffe above the tennis courts (p. 31).

Why is it so coarse? It is a first deposit of that sea as it came over an eroded surface, and the heavier material has been somewhat sorted by its own weight. The coarser layers are not more than 2 or 3 feet thick. The sandstone at the top of the bluff is much finer-grained, as you can see.

This is another contact between the two formations, the dolomite of the first and the sandstone of the second invasion. Such contacts are hard to find in this country heavily covered as it is by unconsolidated glacial and marine sediments.

During the interval represented by this contact an additional 700 or so feet of dolomite was deposited in the Montreal basin, followed by a complete withdrawal of the sea, in turn followed by the deposition of more than 800 feet of limestone in the Champlain valley and 700 feet of limestone in the Montreal basin before our basin was again invaded, and this sandstone just above the contact deposited. That line of contact, then, represents some millions of years of time.

2

Continue along the road which has several twists and turns. Stop after the right hand turn up the hill.

a) In an overgrown quarry on the north side of the road is another contact, in this place between the top of the shale and sandstone of the second invasion and the basal sediments of the third invasion which, you will remember, came not from the east, but over the Frontenac axis (p. 3).

This contact is much less clearly defined than that east of the sawmill. The basal sandy layer is only a few inches thick. Not much sand was exposed when this invasion entered. Above this thin layer lie a few feet of rusty-weathering dolomitic beds, looking very like those below the basal sandstone at the sawmill, but considerably younger in age. As mentioned before, dolomite is a magnesium limestone and may be formed by deposition in shallow water, or by a replacement or exchange of magnesium for some of the calcium. Nothing here indicates by

which method the dolomite was deposited but it is quite evident that at the beginning of the transgression the water would have been shallow.

b) Some fossils are present in the lower formation. Perhaps the best hunting ground is in the thin, rather shaly beds near the base of the small outcrop on the south side of the road. The characteristic fossil is a small brachiopod, *Camarotoechia plena*, radially striated, and having a sharp beak. Down the median part of one valve is a fold and on the other valve a corresponding groove or sinus.

3

Continue on the road turning left at the first rather indistinct corner, following several turns in the road to a large quarry which has been visible for some time. It is cut in the face of a scarp. Between the top of this hill and the contact at the last locality the rock measures some 168 feet in thickness, part of it covered of course. The rock exposed in the quarry comprises the lower part of the limestone of the third invasion, including the same beds as those at the Duntile quarry (p. 24), and some 35 feet of additional strata at the top. The covered part lies below the beds of the Duntile quarry.

a) Note the limestone. There are several variations of it here. Along the west wall are some few inches of interbedded shaly layers.

b) Fossils are very numerous in these beds. Both the corals *Lyopora* and *Strepelasma* are found here. Many types of brachiopods abound. Very common are a number of species of *Rafinesquina*. In fact these beds begin to illustrate the increase of *Rafinesquinas* and the decrease of *Öpikinas* (p. 26). Several varieties of *Strophomena* are common, and *Resserella* is abundant. A lucky person may even find a tribolite almost complete, but certainly heads and tails are present. The easiest collecting ground is on the top of the bluff at the northwest end of the quarry.

FIELD TRIP IV

FOSTER SANDPIT

Distance: Museum to Sandpit 7 miles.

Drive out the Bowesville road. Take the river road at the fork with the Uplands road. On the west side of the road just before the Airport is reached is a large sandpit, the last of several. The sand is outwash from glacial material reworked by the Champlain sea (p. 16).

a) In the low hummocks of sand in the centre of the pit abundant seashells can be found including several varieties of pelecypods (clam type) and numerous barnacles. They are white, not yet completely fossilized. The skeletons of two white whales (*Beluga*) have been found here recently.

b) Note, too, the crossbedding of the sand, and the sorting of the coarser sand into rivulets as it falls from above.

c) In one place, before the centre of the west wall was removed, the ends of rails of a track used to protude from the sand covered by several feet of sand drifted there since the track was abandoned—an illustration of wind action. The whole wall has now been removed.

BILLINGS BRIDGE

Distance: Foster Sandpit to Billings Bridge 4.2 miles.

At Billings Bridge park in the shopping centre, or, if not too many cars, beneath the overhead railway bridge. On the east side of Bank Street, beside the railway, a weed-blocked path leads down to a creek which has cut through black shale, the higher beds of the same shale as that seen on the Montreal Road (p. 31).

a) Note the fissile or breakable character of the shale. There are a few fossils here but not very well preserved. Fragments of a trilobite are occasionally found. More common is the small end of a long tapering cephalopod. A much better place for fossils in these beds is in Bearbrook creek (p. 41).

b) Just west in the curve of the stream before its issue from under Bank Street is a small thrust fault (Fig. 11) visible on the north bank. A few thin beds

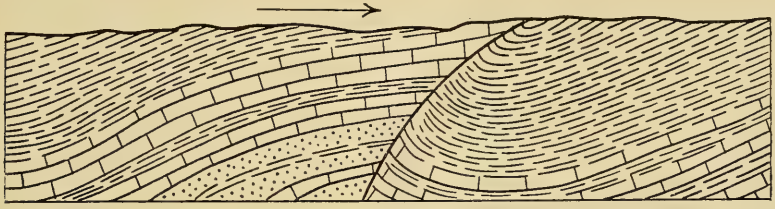


FIG. 11. Thrust fault

of interbedded shale and dolomite, normally occurring in the lower part of the formation, are thrust upward against the higher beds composed entirely of shale.

BARNHART QUARRY

Distance: Billings Bridge to Barnhart Quarry 1.5 miles.

Return by the River road to the Bank Street bridge. Continue east to the Smyth Road. Turn southeast and stop at the Veterans' Health Centre. On the south side of the road is a quarry on the private property of Dr. W. S. Barnhart. Before trespassing it has been customary to ask his permission which has always been cheerfully given. These rocks are at the base of the sediments of the fifth invasion. The formation is represented around Georgian Bay, near Toronto and in New York State. It has never been found as inliers on the Precambrian Shield to the north.

a) In the northeast corner a further excavation has revealed some of the black shales beneath it.

b) In the main exposure note the interbedded grey shale and thin grey dolomitic layers. In some places, particularly in the southeast corner, the thin dolomitic beds are hardly continuous, looking more like a line of nodules. Some thicker dolomitic beds are exposed in the bed of the creek at the west side of the Health Centre.

A little higher strata occur south of Leitrim, not exposed normally but seen when the telephone or hydro poles were put in.

c) In this region fossils in these beds are very rare.

GLOUCESTER FAULT

Distance: Barnhart quarry to Gloucester fault and Morrisburg road intersection 8 miles.

Return to Billings Bridge and drive down the Morrisburg Highway. Near Leitrim the Highway and the scarp to the west are seen to converge. A little south of Leitrim the road descends.

a) The scarp, its outline softened by a covering of later unconsolidated debris, has crossed the road and continues to the southeast. In front is a hill with a valley between you and it. Beneath Leitrim and the road south of it to the slope lie the sediments of the fifth invasion, though the beds are somewhat higher than those at the Barnhart quarry. The hill across the valley is composed of the upper beds of the rocks of the first invasion. A creek runs through the valley and also reveals rocks of the first invasion. The Gloucester fault (Fig. 12) has crossed the

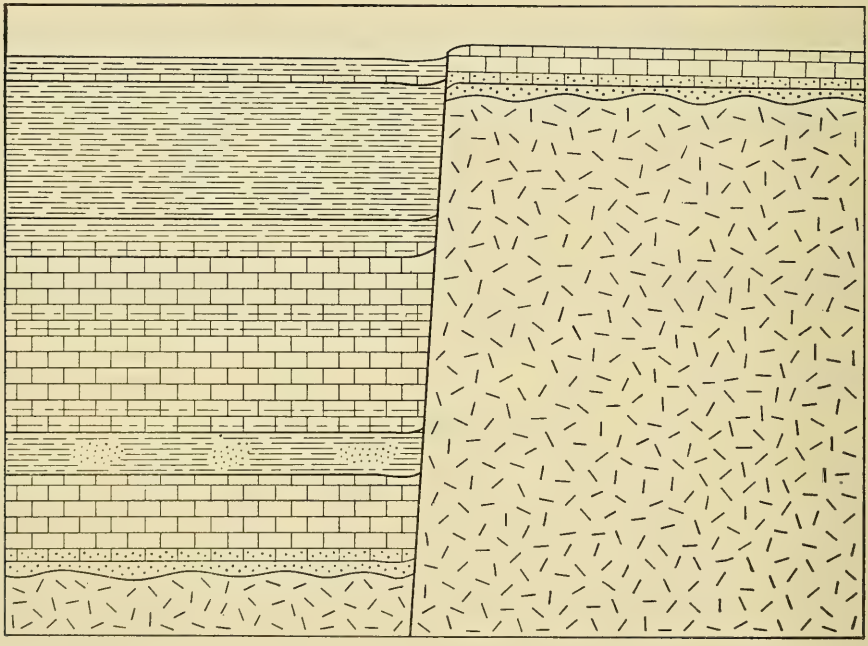


FIG. 12. Gloucester Fault (Castor River bridge, 2 miles west of Russell)

Highway between the creek in the valley and the slope south of Leitrim. The down-faulted block in this vicinity has a displacement of 1800 to 2000 feet. This is the continuation of the same Gloucester fault that crosses Carling Avenue at the Experimental Farm.

BRIDGE CROSSING NORTH BRANCH OF CASTOR RIVER

Distance: Gloucester fault to North Branch of Castor River 5 miles.

Continue south on the Morrisburg road to the turn to Metcalfe. Pass through the village and stop where a north-south road has a little bridge over the North

Branch of the Castor river, about 2 miles west of Russell. Stop at the bridge. It is well, here, to speak to the farmer before trespassing. In some cases emotions are high if permission is not asked! Descend to the north bank of the river on the east side of the bridge. This is at the edge where a fault breaks from the Gloucester fault and follows a northeasterly direction to Rigaud Mountain (p. 14).

a) Note the red shale, distinguishing between loose blocks and exposures in place. This red shale is much better exposed at the next stopping place.

b) Note the loose blocks of grey limestone replete with fossils. There are numerous brachiopods and pelecypods (clam type). One characteristic pelecypod has radial striations. It is indicative of the rocks of the sixth invasion (p. 10).

Only one bona fide exposure of this formation is known. It is 1 to 2 feet thick and occurs in the bed of a creek about lot 24, Concession VII, Cumberland Township. South from the intersection of the road and the creek the road rises a little. When cut through many years ago a few feet of the formation were exposed. Blocks of the excavated limestone lie broken up and overgrown by scrub on the roadside.

RED SHALE QUARRY

Distance: North Branch of Castor River to Red Shale quarry 5 miles.

Drive through Russell, making two turns in the village, the first to the right to the main part of the village, the second to the left just before crossing the bridge. Continue east to the first north-south crossroad about one mile from the village. Turn north. Pass the first east-west crossroad and continue about halfway to the next crossroad. In a field on the west side of the road is an abandoned, water-filled quarry. Opposite the house on the east side of the road a gate leads into the field. Park the cars and walk around the south end of the water-filled quarry, then follow the old track line. Go through a second gateway into the next field, and a large red gash in the earth faces you.

The quarry can be reached by turning north on the road just after entering Russell. But, for some time this road has been so abused by heavy trucks that the longer route is usually the better.

This red shale is trucked to Ottawa where it is combined, three parts red shale to one part local marine clay, to make the brick used in the city. The brickyard, at the time of writing, is on the road to the Uplands Airport a short distance west of the bridge over the Rideau river at Billings Bridge.

a) Note the red shale. Scattered here and there is a nodule. Break it open. The centre is a hard green rock, considerably harder than the shale.

On the north side of the quarry towards the east end is a bay, of sorts, cut into the side. Near its base is a layer of the hard green rock, about 18 inches or so in thickness. It is sometimes covered with debris.

b) On the south wall of this northeasterly excavation, not far from the little pumphouse several joint planes are exposed. On either side of the joint planes a green-grey ribbon about 1 inch wide marks the joint plane. The green is not so vivid as in the nodules and larger layers.

What is the explanation of the red and green? The green colour is caused by ferrous iron, the red by ferric iron, that is, an oxidation of the ferrous iron, like

rusting. But which came first? Was the deposit ferrous iron that later became oxidized? Or, was it ferric iron which was reduced by oxygen-absorbing plants or bacteria? The question is open. One thing, however, is evident. The two grey-green ribbons on either side of the joint planes show a reduction of the red shale by the infiltration of oxygen-absorbing vegetation or bacteria in water seeping into the crack. On the other hand a broken nodule with green ferrous iron centre would seem to owe the origin of its outer colour to the oxidation of the exterior.

c) Until recently no fossils have been found in this quarry. An ostracod, *Drapenella,* has been described from the same beds at Georgian Bay, but that is all. The same form occurs here, but in addition quite a collection of material has been made recently: poorly preserved branching bryozoans, a few brachiopods and even a few trilobites. They have not yet been described.

During this period, then, of some 70 million years or so, this basin was gradually filled up to the depth of 1800 to 2000 feet. The process was intermittent. The basin was probably never very high when uncovered. Some transgressions of the invading sea entered from the east and some from the southwest.

FIELD TRIP V

PAKENHAM

Distance: Ottawa to Pakenham bridge 39 miles.

Leave Ottawa via Carling Avenue or Wellington Street, taking Highway 17 at Britannia Heights. Drive through South March, Carp and Kinburn to Antrim. Leave Highway 17 at Antrim, continuing on the road straight west. There are one or two jogs on the last half of the road, but as you near Pakenham the road turns abruptly to the right, and gradually descends to the Mississippi River. On the right of the slope is a quarry. At the foot of the hill a left turn brings you to the Pakenham bridge. Park cars here, and return to the quarry on foot.

a) The rock belongs to the lower part of the Black River - Trenton beds corresponding to the Duntile quarry beds.

b) The lower beds are not very fossiliferous, though some fossils are found in the talus fallen from above. About 15 or 20 feet above the floor, on the north edge is a bed with masses of 'fucoids.' They show no structure other than irregular clumps of stems, but they are believed to be the remains of seaweed (algae), a low type of plant life.

Frequently pieces of trilobites can be found and a very small coral, *Tetradium,* usually altered by secondary calcite. At the top of the quarry are beds bearing the large 'honey-comb' coral *Lyopora halli,* and another form, *Receptaculites occidentalis* (p. 49).

Cephalopods (p. 58), like those of the Duntile quarry are, also, fairly common in these beds. Some of them are firmly embedded in the rocks just below the bridge. Most of them here belong to the type having a bead-like siphuncle.

SANDSTONE OUTCROP

Distance: Pakenham bridge to Sandstone outcrops 2 miles.

Cross the bridge and turn to the left, driving on Highway 29. About two miles south of Pakenham the Nepean sandstone outcrops intermittently for some distance, lying between the Highway and the river.

This is the same sandstone as that at the Campbell quarry (p. 23). It is the first sand deposited upon the ancient Precambrian base. In many places on either side of the road Precambrian knobs rise above the level of the sandstone, showing that it fills the valleys between the buried hills.

OUTCROP OF MARCH ABOVE THE SANDSTONE

Distance: Pakenham bridge to Almonte road 10 miles, to outcrop ½ mile.

Continue south on Highway 29 to the first road on the left leading into Almonte. But turn right, to the west, on the country road. A short distance from this corner, along the north side of the road are intermittent bumpy outcrops of dark rusty-looking rocks. Stop and examine the second or third exposure. This rock is the same dolomite as that seen on the scarp at the Campbell quarry on the truck road to Highway 15 (p. 23). The characteristics of the formation, however, are more easily seen in the latter outcrop.

a) Notice first the rusty colour due to iron. It was evidently deposited in a shallow sea, and then exposed to weathering.

b) Note the interbedded sandstone and dolomite. The sand is coarse and rather dirty-looking. The dolomite layers frequently have sand grains embedded in them.

As mentioned above (p. 5) the erosional interval between the close of the Precambrian and the invasion of the first sea from the east was approximately 500 million years. The Nepean sandstone along Highway 29 is the result of the reworking, sifting, and sorting of the eroded material by that invading sea, which in turn, continued to dissolve the solubles and add the insolubles to the supply. Gradually the carbonates in solution would become more and more concentrated and were deposited. A first layer would form, leaving the water with few solubles. Then the sand that remained loose would be moved about. Again in time the solutions would become more and more concentrated, and again would be deposited. Gradually all sand would be covered and only the carbonates deposited. Farther east we have seen (p. 7) that is just what happened. Right here we are near the western margin of the sea, near the shore line, which accounts for the number of Precambrian knobs outcropping so near the interbedded sandstone and dolomite beds. Farther east these beds of intermingled dolomite and sandstone are covered by thick beds of dolomite only.

FIELD TRIP VI

EAST OF MOREWOOD

Distance: Ottawa to Morewood 37½ miles, to outcrop 1 mile.

Take the Morrisburg road, turning off at the Metcalfe road, and drive to Russell. Here turn south, following the road to Morewood. Turn east and about 1 mile east of the village is an outcrop.

These rocks contain the brachiopod *Camarotoechis plena* seen at stop 2b south of Rockland (p. 34), and along the north shore of the Ottawa River near Deschênes, and west of it. It is indicative of the second invasion entering over the Beauharnois axis. The beds are very close to those that held the same fossil in 2b (p. 34).

None of this limestone is found west of the city of Ottawa. Just as the Nepean sandstone of the first invasion was eventually covered by the dolomite, as seen in

the scarp at the Campbell quarry, so the sandstone and shale of the second invasion was covered in its eastern part by limestone when the calcium carbonate in its water was sufficiently concentrated to be precipitated.

PAYNE RIVER, SOUTH OF BERWICK

Distance: Last outcrop to Crysler 7.3 miles, to crossroad south of Berwick 5 miles, to Payne River ¼ mile.

Continue from the last outcrop east of Morewood to Crysler. The rocks exposed in the river here belong to the same beds as those beneath the White Bridge (p. 29). The same large, irregular beds of black chert are to be found but fossils are scarce. Turn south over the Crysler bridge, and continue south through Berwick to the first crossroad. Here turn east, stopping at the bridge over the Payne River. The limestone outcropping in the river is a deposit of the third invasion, and is practically at the same horizon as the beds in the old quarry west of Finch, to be seen later (p. 40). This series of outcrops, also, can be followed north from the bridge at Finch. In some places fossils are numerous.

These are the Sherman Fall beds, occurring above the outcrop in the river at Crysler and above the big quarries on the Montreal Road, east of Ottawa. There are no good exposures of them near the city of Ottawa.

QUARRY WEST OF FINCH

Distance: Payne River to crossroad to Finch 3 to 4 miles, to quarry east of Goldfield 2 miles.

Return to the crossroad, and turn left (south) to Finch. At the Highway through Finch turn to the right (west) and drive two miles. On the north side of the road is a quarry easily seen because of the dumped contents of old rusty machinery. These beds are representative of a part of the Black River - Trenton deposits of the third invasion (p. 8). Frequently they have thick layers which weather rubbly, or thinner beds with considerable shale. The latter are more evident where weathering has followed cutting for road building. They pass upward stealthily with very gradual change into the beds that form Parliament Hill.

Fossils, particularly brachiopods, are more abundant here than in any other outcrop visited. Trilobites are not so numerous but they can be found. A hat-shaped bryzoan, *Prasopora*, is so prolific wherever the beds are exposed that the strata are often called the *Prasopora* beds.

SCARP NORTH OF NAVAN

FIELD TRIP VII

Distance: Ottawa to outcrop 19 miles.

Drive to the Navan - Montreal Road intersection via Hurdman's Bridge and St. Laurent Blvd. Just beyond Green's creek, where the old and new Montreal Road divide, take the old road. About half a mile beyond Daniston (no road sign) turn to the right (south) on a straight, broad road going up an incline.

A crossroad intersects the main road half a mile after leaving the Montreal Road. Again half a mile to the left on the crossroad is a feature which may be a point of interest to some. A creek goes underground beneath the road and for

some distance to the north and south of it. In summer time the bed of the creek is dry, revealing rocks of the same age and containing the same fossils as the upper beds of the Duntile quarry. The section represents a few feet of the Leray beds of the Ottawa formation roughly about 125 feet above the base of the 700 feet of sediments.

Continue on the Navan road. At 19 miles from Ottawa, omitting the mile to and from the subterranean creek, a ridge of rock crosses the road in an east-west direction. It is to be remembered here that all concession roads and crossroads in the area are not north-south and east-west but northwest-southeast, and northeast-southwest. This east-west ridge is a long narrow tongue projecting from a much larger area of outcrop to the east.

a) The rocks of the scarp belong to the same beds as those of Parliament Hill, or those at Rideau Hall gate. But they are weathered naturally and it is much easier to find fossils: gastropods (snail types), cup corals, occasionally trilobites and a number of other forms—if you search.

b) Looking back from the top of the slope it is evident that the ground is higher than at the subterranean creek, if it is visited, and much higher than at the river. In addition to the surface elevation the dip is southerly which results in the exposure of higher beds as one proceeds south.

This outcrop is in the upper 100 feet of the Cobourg beds near the top of the 700-foot formation.

SECOND OUTCROP

Distance: from scarp north of Navan to Murray's Hill 4½ miles.

Continue southerly to Navan. Here turn east towards Sarsfield. About 4½ miles from the scarp north of Navan you descend another edge of the large outcrop of which the scarp was a prong. These, also, are the Cobourg beds. They contain the same fossils, though they are not usually so rewarding as at the first exposure.

BEARBROOK

Distance: from Second outcrop to Bearbrook Creek 3 miles.

Continue east for less than half a mile to the first north-south road before Sarsfield. Turn south and pass through Leonard stopping at the second bridge beyond the village. This is Bearbrook Creek. Deepening of the creek for good drainage has resulted in the piling up of loose blocks of black shale taken from the bottom of the stream. The shale belongs to the same formation as the outcrop seen in the creek by the railway at Billings Bridge (p. 35). But a very fossiliferous layer has been exposed here. The trilobites are especially outstanding. In the lower beds and a few feet above them are numerous pygidia (tails) of a rather large trilobite, *Ogygites*. When full grown it may be three to five inches in length. The other trilobite, *Triarthrus*, is quite different. It is small, about one or one and a half inches in length when complete. And, unlike the *Ogygites*, the head is preserved more often than the tail. This form begins at the top of the lower beds, hardly fraternizing with the disappearing *Ogygites*, and continues right to the top of the shales.

It, too, exhibits the trilobed characteristic of the class. The central axis is a little more than a third of the width and its lateral furrows represent the fused segments.

Another newcomer in this region, occurring in these black shales, is a group of graptolites (p. 61). Like the trilobites they are now extinct.

Another rather common fossil here is a cephalopod, *Geisonoceras,* found also at Billings Bridge. It is a straight type, tapering to a very fine initial chamber. Some beds of this black shale yield another cephalopod, *Trocholites,* which is coiled. It is not the first coiled cephalopod to appear but it is an early one. Unfortunately it is not very common.

FIELD TRIP VIII

Not many formations are to be seen on this Trip, and fossils are few, or non-existent. The chief value of the excursion lies in the fact that the formations which are exposed can be visited in the order in which they were originally deposited.

The second, third and fourth sections of this excursion are the lowest sediments of the Third Great Event. They were deposited by the first invasion from the east over the Beauharnois anticline—first the insoluble sand, upon that, sand and dolomite when sufficient of the solubles were concentrated for precipitation, and upon that the dolomite covering all the sand (p. 7).

PRECAMBRIAN SPUR AT CARP

Distance: Ottawa to east of Carp 21 miles.

Take Highway 17 to the corner where one road continues south and the other turns west, just east of Carp village. On the right is a long, low point of Precambrian rocks, a part of the spur which projects in a southeastern direction from Fitzroy Harbour to South March (p. 20). The Feldspar Quarry in Field Trip II is also within the same spur.

There is no particular quarry in the rocks in this locality, but a study of the region exhibits a variety of rocks of the Canadian Shield.

SANDSTONE QUARRY

Distance: Corner to Sandstone Quarry 2 miles.

Drive north, returning on Highway 17 for 2 miles. On the east of the road is a quarry in the Nepean sandstone. Indeed, up to the corner the sandstone is exposed at short intervals along both sides of the road.

This is the same sandstone as that of the Campbell quarry (p. 23). It is the first sediment deposited upon the Precambrian rocks after the First Long Erosional period.

HARWOOD PLAINS

Distance: Sandstone Quarry to Harwood Plains 2.3 miles.

Drive north to the corner where the road to Dunrobin leaves Highway 17. Turn west and drive to the corner at Harwood Plains, stopping en route wherever it seems desirable.

On both sides of the road and back in the fields and woods are exposures of the March formation. This is the same mixed sand and dolomite formation as that seen in Field Trip II (p. 20). Most of the exposures are flat-lyings and the interbedded sandy dolomite and dolomite is not very evident.

WINDING ROAD

Distance: Harwood Plains to corner, meeting road from the north 2.7 miles.

The road winds this way and that, up and down small slopes, reaching its lowest elevation just east of Constance Lake. It is bordered on either side by good exposures of Oxford dolomite (p. 7), until it turns west towards the junction with the next road on the north.

These three formations then, Nepean, March and Oxford, lie undisturbed in the order in which they were deposited by the first sea that invaded the basin after the long erosional period, subsequent to the Precambrian (p. 7).

Another formation, the Rockcliffe, is exposed at the corner. Between the deposition of the last exposure of the Oxford and the first of the Rockcliffe a relatively short erosion interval occurred. The sea withdrew over the Beauharnois anticline, stayed long enough in the Montreal basin to deposit about three times the thickness of rock and then withdrew farther to the east. After a relatively short emergence the land again subsided. The sea again returned depositing some 890 feet of sediments in the Champlain valley and more than 700 feet in the Montreal area before it again spilled over the Beauharnois anticline into our basin. The beds of grey Rockcliffe sandstone at this corner, then, are deposits of the second invasion from the east.

PINHEY ROAD

Distance: Corner to the Pinhey road 2.3 miles.

Take the north road to the next intersection. Turn west, towards the Pinhey farm. From this corner west are scattered outcrops on either side of the road. The rock differs from that seen so far. Occasional dolomitic beds occur, but most of it is limestone. This is a part of the lower deposits of the Ottawa limestone of the Third Invasion which entered this basin, this time over the Frontenac axis.

OTTAWA RIVER

Distance: Pinhey Road to top of hill above Ottawa River 2.5 miles.

Continue west to the next intersection and turn north to the Ottawa River. Stop at the top of the hill leading down to the river. Look at the rock carefully as you descend. At the top it is very similar to that seen along the Pinhey road, but it changes rapidly in the descent to the river: limestone and shale, dark shale, then a greenish shale, occasional dolomitic layers, often containing sand. Somewhere between the dolomitic layers and the shore is the line between the base of the Ottawa limestone of the third invasion and the topmost sediments, in this area, of the second invasion.

Outcrops occur along the slope of the river bank to the west, the part exposed varying according to the position of the irregular covering of overburden and trees.

To understand the number of differing types of rock within such a limited area it is necessary to visualize the conditions. The second invasion had retreated leaving shale and sandstone. It had never transgressed the Frontenac axis, nor even extended as far west as the first invasion. So when the third invasion began to enter over the Frontenac axis its shores first lapped the ancient Precambrian rocks, dissolving some and pushing onward some of the insolubles. In time it

reached the margin of the deposits of the first invasion, dissolving and reworking them, then it crossed the sandstones and shales of the second invasion carrying with it the mingled solubles and insolubles of all the types over which it had passed. Small wonder that the first few feet at the line of contact were a mixed lot.

ROAD CUT

Distance: Ottawa River to road cut 1.75 miles.

Return south. Pass the intersection with the Pinhey road and continue to the road cut. The same limestone of the basal beds of the third invasion outcrops intermittently along the roadside. It is a continuation of that seen on the Pinhey road, but it is better exposed in the road cut. These beds are considerably higher and somewhat more uniform than those near the river bank.

CROSSROAD

Distance: Road cut to first crossroad about ½ mile.

Continue south to the next crossroad. Right at the corner is an outcrop of the Rockcliffe sandstone previously observed in this excursion.

An irregular terrace crosses the peninsula. The Rockcliffe sandstone can be followed from this spot back to the corner visited on the fourth lap of this excursion, maintaining approximately the same elevation. Deeper in the woods between these two points is a cliff of it, probably worn out when the river was at a higher level making this peninsula an island.

It can be seen that above the Rockcliffe sandstone, the limestone, a deposit of a later invasion, forms another terrace along the road at a higher elevation. Both formations are exposed irregularly because they are covered by loose, unconsolidated material.

ROAD OUTCROP, DUNROBIN TO HARWOOD PLAINS

Distance: Crossroad to Dunrobin 1.6 miles, Dunrobin to Harwood Plains 3.6 miles.

Continue south through the swamp and across the bridge to Dunrobin. The stream is the outlet for Constance Lake and flows into Constance Bay. It and the swampy lowland through which it passes are probably an old course followed by the Ottawa River when the water was higher. Cross the railway track and follow a low ridge, on the left (north) side of the road and almost paralleling it. This is another and a better exposure of the Oxford, the uppermost formation of the first invasion, though not the top of it. It passes almost imperceptibly into the underlying March as you go east to Harwood Plains.

ISOLATED OUTCROPS

BRÉBEUF PARK

Take the Aylmer road from Hull. Drive to the village of Val Tétreau. About the centre of the village a road leads down to Brébeuf Park on the Ottawa River. Rock outcrops all along the shore.

a) These rocks belong to the third invasion that entered the basin over the Frontenac axis. They correspond to the upper part of the formation exposed in the Duntile quarry (p. 24), and contain the same type of fossils.

b) To the east the rocks rise above the shoreline and dip at different angles. Climb over them and you come to a bay. Through the bay runs the Gloucester fault, the raison d'être of its existence (p. 14). The tumbled rocks are the broken edges of the fault. Most of these slices represent beds higher than those of the flatlying shelves on the shore. Across the river the continuation of the fault can be traced by the dip of the rocks at the filtration plant, and on the surrounding islands in front of a corresponding bay on the Ottawa side of the river.

NORTH SHORE OF THE OTTAWA RIVER

Leaving Val Tétreau drive out the Aylmer road. Turn down to the river at Deschênes, the Gardens or at Aylmer. The shore is lined with good exposures of the Rockcliffe sandstone, the deposit of the second invasion from the east (p. 8). This is the same sandstone as that at the Britannia Yacht Club (p. 24) and at Rockcliffe (p. 30).

In some places and in some layers a brachiopod, *Camarotoechia plena,* is to be found. It is the same form as that occurring at stop 2b on the way to the Rockland quarry (p. 34).

SOUTH SHORE OF OTTAWA RIVER

Another series of fossil-bearing outcrops occurs along the south shore of the Ottawa River, opposite Brébeuf Park. The place can be reached by going north on Parkdale Avenue.

These rocks are practically the same here as those on the north shore, the deposits of the third invasion over the Frontenac axis. Higher beds skirt the bay to the east. This bay, too, is caused by the Gloucester fault, consequently the rocks dip towards it, dragged down by the down-dropped block to the east upon which the city of Ottawa stands. Walk west from here. Older and older beds are brought to the surface. Gradually the fossils disappear as the older beds are exposed, until finally the sandstone lens at the Yacht Club is reached in which there are no fossils.

RIVER BED EAST OF RUSSELL

Take the road to Russell. Just east of the village descend to the river bed. Follow it up to the second north-south bridge.

The rocks dip slightly to the east with the result that the farther you proceed downstream the younger are the rocks exposed. In that distance you pass from the rocks of the second invasion up almost to the middle of the deposits of the third invasion.

Fossils become increasingly abundant as the higher rocks are encountered.

QUARRY AT TOP OF SECOND INVASION, EAST OF ROCKLAND

After passing through Eastview and the part of Ottawa that continues east of it, take the Old Montreal Road a little beyond Green's Creek. Drive through Orleans and stop just over the crest of the hill immediately before Cumberland.

The top of the hill has one of the beautiful views of the slope to the Ottawa River, across the river and on to the hills beyond which are really the roots of ancient mountains. It also shows the electric towers marching over the hills, over the water and up over the height on the south side crossing the country beyond to carry light, heat and power to the people all along the way.

a) Just over the crest of the hill, on the south side of the road is a gash in the side of the slope, partly overgrown with grass, exposing some of the thinly interbedded shale and limestone beds of the upper part of the sediments of the second invasion (see p. 8). Some specimens of *Camarotoechia plena,* characteristic of this part of this invasion, can be retrieved by careful search.

b) One feature of the geology of the countryside is to be seen all along this route. During the Second Great Erosional Period (see p. 12) there was a great rending and breaking of the earth's crust. Blocks of the crust fell or were somewhat pushed up in relation to the neighbouring blocks. The results can be seen here in the surface conditions of the country. The top of almost every hill over which the road passes is the top of a displaced block. Looking across a valley, following the direction of the road, another hill can be seen—the top of the next block. With the eye follow the line of the hill towards the river. The hill outline becomes lower, but the rock at the base of the hill can be seen, often tapering to a narrower width. The new road to the north cuts through many of these blocks just before they disappear beneath the river.

But the fact that they are separate blocks is better seen from the old road. The ridge to the right is deceiving. Instead of a sharp rise and drop from block to block, a more or less level scarp seems to skirt the road to the south. Why? The debris of the Champlain sea (p. 16) has filled in between the blocks and levelled the surface. Back of that scarp in many places is a level tract of sand.

c) Continue on the old road beyond Rockland, till a rather sharp turn in the road exposes a small quarry in the hillside. Just beyond the quarry a small gravel road runs to the river on the north side.

Again, in this quarry, the thinly interbedded dark shales and limestones are exposed. This outcrop is a little higher than that occurring just before Cumberland. The same characteristic fossil is there.

It will be remembered (see p. 24) that around the city of Ottawa and west of it, the beds of this invasion were composed of a fine grey sandstone seen at the Britannia Yacht Club and at Rockcliffe. The sandstone is present here but buried beneath the interbedded limestone and shale deposits. It can be seen at the lower elevation of the new road in many places. The shale and limestone occur only east of the city.

Picture the encroaching sea pushing its shore westward, depositing shale and sandstone as it moves westward, but all the time dissolving the solubles it encounters, or those that are carried into it by streams. In time the soluble material becomes concentrated and is deposited in thin layers at first. Farther east, where the sea has been for a longer time the concentration would be greater, the beds become thicker, the shale is covered more and more by limestone. East of Hawkesbury, south of the highway, is an exposure where the thick limestone beds almost eliminate the shale.

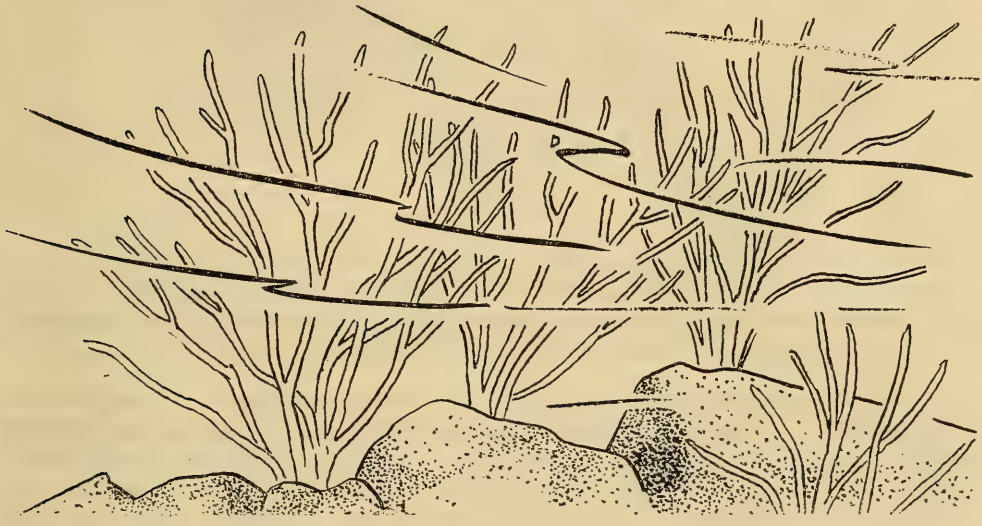
PART THREE

SOME TYPES OF FOSSILS FOUND IN THE AREA

The fossils described here are those which are most often found in field trips in the neighbourhood. There are many other rarer forms, but they often involve a long and frequently frustrating search. In addition most of them are farther afield than one day's outing would permit.

PLANTAE ?

(Plate I, Fig. 12)



Some primitive plant-like forms are found in the rocks deposited by the seas that invaded our basin again and again. If they are true plants they are algae, but many authorities are doubtful. Their nature cannot be proved because they show no cell structure, but, as they look like plants and because they are fairly common in some beds, they are included here. At this stage in the earth's history no land plants had been evolved.

One of the more common types, *Licrophycus*, apparently grew in clumps, rooted or floating. It had simple, leaf-like outgrowths arising from a centre like any plant and attained a height of six or eight inches. It is easy to visualize the clumps floating in the water like the 'weeds' of the Sargasso sea, or more or less stationary, covering the seafloor with their "leaves" upborne by the supporting water and gently rising and falling or mixing with one another, or even torn apart in a storm to be left lying helter-skelter broken as we find them now.

Another of the more common forms, *Bythotrephis* (not illustrated here), had a somewhat irregular, flat 'leaf' which may have floated like kelp. It, too, had irregular branching leaves, if leaves they were. As a fossil it is a dark network on the rock, looking like carbonaceous material.

PORIFERA
Sponges and Near Sponges

(Plate I, Fig. 9-11)



The sponges found in this area are of varying shapes and sizes. All except one rare form are compact, whether one or three inches in diameter.

Sponges in general are spherical or somewhat vase-shaped. A sponge is a lowly creature. It has neither mouth, digestive system, nervous system, nor internal organs. There is an outer and an inner skin with varying amounts of soft matter between, the mesogloea. The whole encloses a central cavity, either circular, oval or star-shaped in section. The cavity has an opening at the top. The outer and inner skin are pierced by pores leading through straight or rambling canals into the inner cavity. The latter is lined with little whip-like hairs or cilia armed with stinging cells. The motion of the cilia draws in water through the canals. Oxygen is absorbed from the water and the stinging cells kill the microscopic food in the water, and at the same time cause an outgoing current for waste matter through the opening at the top.

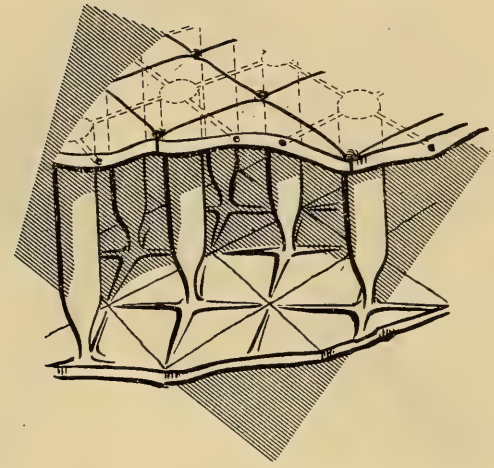
Scattered throughout the soft matter, for support, are siliceous spicules, or, more rarely in fossils, calcareous spicules. They may be single, three- or four-pronged, or very irregular.

Quite a number of sponges occur in the rocks of the Third Invasion, both in the Leray-Rockland beds and in the Cobourg beds. They vary greatly in size and shape: small and large, spherical forms, cylindrical forms, obliquely growing forms (possibly the result of crowding) and one rare branching form.

One sponge is found in the unconsolidated clay deposits of the Champlain sea, the last invasion to date. The spicules are single, often one to two inches in length. They were evidently the support of a spherical form the soft parts of which have disintegrated, and the spicules have fallen flat like the radii of a circle.

Near Sponges

(Plate II, Fig. 1)



Receptaculites is an orphan. It has no living descendant, but is generally thought to be more closely related to the sponges than to any other known group. Though not very prolific in many other parts of the world it is fairly common in this area, particularly in the Leray-Rockland beds. For that reason it is included.

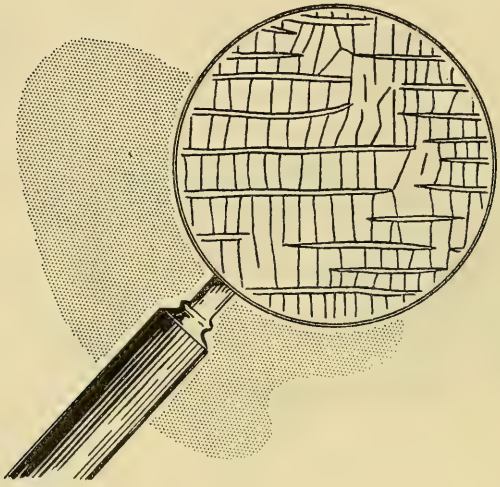
The species of *Receptaculites* found here is a disk-shaped fossil with a funnel-like centre, the whole about three inches in diameter and an inch or less in height. The upper and lower surfaces are composed of thin, rhomb-like plates growing out from the central funnel in a flat spiral. Each upper plate has a lower plate opposite it. The two opposite plates are connected by a hollow pillar, contracted near the lower end. The upper part of the hollow pillar opens into four canals within the upper plate, each canal leading to one of the four sides of the plate and meeting the opening of the corresponding canal in each of the four adjacent plates, thus providing a connected canal system. At the base the hollow pillar again divides into four, but here the four canals lie on top of the inner surface of the lower rhomb-like plate and are directed towards its four corners, again meeting the ends of the corresponding canals at the four corners of the adjacent lower plates. The canal system evidently was concerned with water circulation, but because there is no known living representative of the group nothing is known of the soft parts of the creature.

In some cases the plates of the upper or lower surface are found. Other fragments are broken transversely across the inner pillars exhibiting only a group of regularly arranged small circles. The two aspects are very different. Unless the structure is known it is hard to believe that they belong to the same species.

Ischadites and *Pasceolus* are two other orphans, not included here because they are rather rare. When present they are found in the Cobourg beds. They, too, are thought to be more closely related to the sponges than to any other group.

STROMATOPOROIDEA

(Plate II, Fig. 2)



This group is something of an orphan. It has no living representative, and like the *Receptaculites* no one can be quite sure of its relationship to other fossils. Most authorities, however, put it in a group or phylum which includes modern Hydrozoa as its lowest type and Corals as the highest type, though it is so different from either that it has even been suggested that the group might be different types of algae.

Many of the coral reefs of ancient times contain as many 'Stroms' as corals, and in many instances, those reefs are great oil reservoirs. 'Stroms' are not very important here. They occur as isolated individuals, never in reefs.

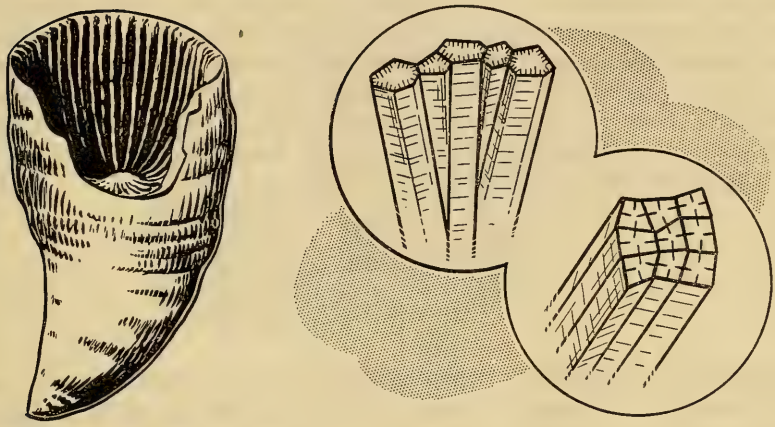
The various forms are often very massive, or they may be small encrusting species. Their structure is microscopic, being composed of a series of concentric layers or laminae penetrated by radial pillars, or hollow rods. Different species have a different arrangement of the pillars or rods, as the case may be. Some pillars are very short, extending only from one concentric layer to the next, others vary in the number of layers they penetrate. On the surface some have minute pores with or without small star-like clusters of radial canals.

'Stroms' have been found here in beds of the Third Invasion about 130 feet or so above the base of the deposits. They occur at the Pakenham quarry, the Duntile quarry, and the Rockland quarry.

ANTHOZA

Corals

(Plate II, Fig. 3-8)



Two types of corals, simple and compound, occur in some of the localities to be visited.

The simple coral has been the home of one isolated individual. Most of these are horn-shaped. They are even called 'horn corals,' sometimes. Each individual is pointed at the base where it is attached to another coral, to a piece of rock, or to a shell. The outer shell of the coral expands upward rather rapidly with growth attaining approximately three-quarters of an inch or more in diameter at its full height of one and one-half an inch. The outer shell, secreted by the outer skin or mantle of the soft parts, supports the whole. Internally the lower part of the shell is strengthened by the secretion of vertically placed septa. These septa extend to the centre in some forms. Their ends twist together forming a confused pillar-like structure which still further strengthens the shell, and, in many, projects slightly upward as a boss which forms the floor of the living chamber. Another form of simple coral strengthens itself by limiting the septa to the inner margin of the horn-shaped shell and secreting flat plates almost from wall to wall across the centre. Above the boss or the last flat plate is the living chamber. Here the animal dwelt extending its tentacles from the open, upper end.

A compound coral is a group of corallites each smaller than one of the simple corals, but all bound together by an outer shell, forming a colony. The outer shell is frequently destroyed in the fossil forms. A colony may be any size up to a foot or more in diameter. In most cases each corallite of the colonies found in the area has a prismatic wall of five or six sides, or young individuals within the colony may even be three- or four-sided because, having budded from older individuals, they have not room for full development until the more or less hemispherical colony has grown upward and outward acquiring a greater radius in which there is more room for growth. The septa of the compound corals do not, as a rule, extend to

the centre as in some individual, simple forms. They are just long, inconspicuous ribs or striae on the inner wall of the corallite. Thus they do not meet in a central columnella. As the colony grows upwards, each corallite in its prismatic tube-like home secretes a succession of tabulae or tiny floors cutting off its past so that when the colony is seen from the side, row upon row of corallites are visible, each with its transverse plates succeeding one another throughout its whole length.

One type of compound coral found here, *Tetradium*, has a misleading form. It appears to have septa, most commonly four in number. But these are not true septa. They are formed by the penetration of the wall into the corallite. They continue to grow until they meet in the centre and divide the corallite into four small individual corallites. Such is the method of reproduction of *Tetradium*—by fission as compared with the more usual types of compound corals that reproduce by budding from the side of the older corallites.

CONULARIIDS

(Plate II, Fig. 9)

The conulariids are another orphan group. They are represented in our basin mainly by the genus *Conularia*. Each specimen is made up of four plates, each plate shaped like a long isosceles triangle. The plates are attached to one another on their long edges, having a groove along the line of attachment. The result is a slender, four-sided pyramid, but with the large end uppermost. At this upper end a portion of each plate is free from its adjacent plates, triangular in shape so that it could fold over the opening. Together the four triangles make a covering entirely enclosing the creature within its four fancy walls.

At the small end, in some forms of the group, a flange-like expansion at the bottom suggests that they were attached to something. The tip, in some forms of the conulariids, is separated from the main body by a diaphragm cut through the four walls and the interior. The purpose of the diaphragm is not evident but the result is that the two parts frequently become detached.

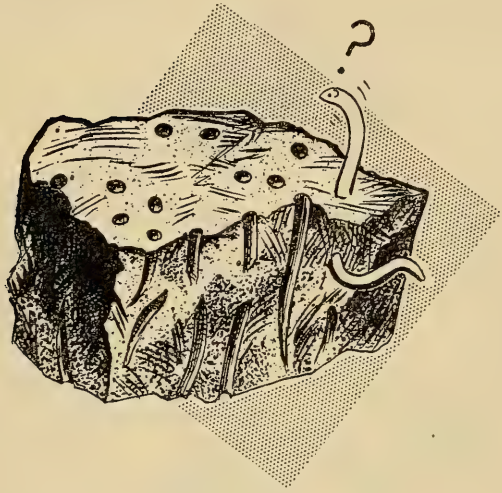
The outer surface of this small end is smooth but the main shell is often highly ornamented. Down the middle of each plate is a ridge. From the ridge to its outer edge there are fine, closely placed horizontal striae. Between the striae are very short, still finer, vertical striae.

The whole group has been placed here and there, with the worms, near the gastropods, near the corals, in fact in or near many different groups, because, like a number of other fossils found here, there is no living representative to show the organization of the soft parts. More recently, it has been suggested that the group may be cousin of the jelly-fish type belonging to the Scyphozoa, not far from the corals.

In this area some specimens are found intermittently at several levels of the beds of the Ottawa limestone, but most commonly in the Leray beds, as exposed in the Duntile quarry, and in similar beds at other localities.

VERMES

(Plate I, Fig. 1; Plate II, Fig. 10)



The word 'Vermes' is a general one for worms. There are many divisions and sub-divisions of worm groups. But the general name is appropriate here because there isn't any worm, just a hole where the worm is supposed to have been. Nobody knows exactly what kind of worm it was, if any. The Nepean sandstone, the base of the First Invasion deposits, is riddled with these burrows in some places.

It is not possible to describe them because they are just hollow, tube-like holes in the sandstone.

One good place to see them is south from Eagleson's Corners, the next corner east from Hazeldean. At this corner turn south, and, after passing the first house on the east cross into the second field and follow the long ridge of rock south almost to the old shed. The ridge is formed by the March beds and shows fine examples of the large inclusions of secondary crystalline calcite. Farther south, near the shed, the Nepean sandstone outcrops beneath it, in places filled with these 'worm' holes.

After examining the worm holes turn towards the house nearer the road, pass through a gateway into another field and note the sandstone outcrop just beside the fence that lies between the exposure and the barn.

The sandstone is made up of great swirls, each with a hard quartzite centre. The beds below are flat, and the beds above, across the field, are flat. Explanations are in order. Several have been suggested but none proved. One possibility is a slump before consolidation, but why the almost uniform size of the quartzite centres, and the uniformity in the size of the swirls ? Another suggestion is that the unconsolidated sand has been pushed by ice on the seafloor. The same objection holds for this theory, and the additional one that no other evidence has been found indicating ice at the time.

This place might be included in Field Trip II, if desired.

Another doubtful type of worm is shown here. It is a bit incomplete, but shows a hard chitinous or horny shell with very fine, irregularly spaced, wavy lines crossing it transversely. It is broad and very flat, having uneven sides suggesting that it may have grown in a cluster. The form is not very common but can be found in the Cobourg beds.

BRYOZOA

(Plate II, Fig. 11-18)

One of the most common groups, and one of the most difficult to identify generically and specifically is the Bryozoa.

Bryozoa still live, so their internal organs are known. The fossil forms often look like corals, though they are much more minute and are distinctly higher forms of life.

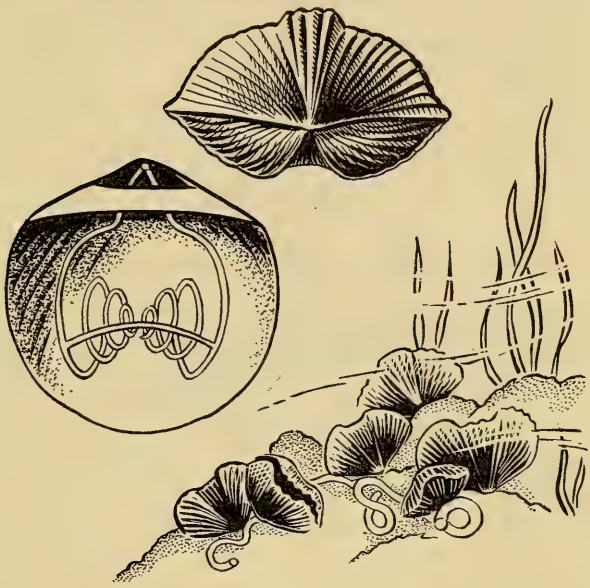
Bryozoa live in a colony, but each individual is an entity in its tiny apartment home, and the form of the home has to be examined with a microscope. The outer surface of a colony looks like a collection of minute pores, whatever the shape of its apartment house. It may be hemispherical, growing upward and outward. It may be in the form of round cylindrical branches with its small openings, or zooecia, all around the branch, or as flat branches with the zooecia opening on either side and none on the sharp edges. In that case the two pore sides have no connection with one another, being separated within by a flat partition. Or, the colony may be a flat growing network with interspaces, in which case, the pores are on one side only, the other side being roughly striated, perhaps to make it more stable as it lies flat. In other cases Bryozoa are encrusting, generally on other shells.

Each individual bryozoan in its organization is very like the following brachiopods, and for many years they were put together. But brachiopods are single, and much larger than the tiny individuals of the bryozoans which also differ in living in colonies. So more recently they are considered to be entirely separate groups.

Bryozoa can be found in our basin at almost any level in the 700 feet of deposits of the Third Invasion. They are especially numerous in the old quarry west of Finch. They, also, occur in numbers in the loose blocks of the Seventh Invasion in the bank of the North Castor River west of Finch.

BRACHIOPODA

(Plate I, Fig. 4-8; Plate III, Fig. 1-22)



Living brachiopods are too rare to have acquired a popular name. Each brachiopod has two shells, or, in other words is bivalved. The valves are unlike. One may be convex, the other flat or concave. One may have a fold down the middle and the other a complementary trough or 'sinus' down the middle. On the other hand each valve, however it differs from its mate, is divided equilaterally, if an imaginary line is drawn from the beak to the middle of the opposite side. Some forms open and close along a straight margin or hinge on either side of the beak (Plate III, Fig. 15). Others come to a point, opening and closing just at the beak. The two valves are ornamented in the same manner, in some genera being smooth except for concentric growth lines, in other cases ornamentation is by fine or coarse striae radiating from the beak. The creature was originally attached to a rock or another shell by a muscle issuing at the beak. The larger, opposite margin was free to open and shut to take in the food-laden water.

Internally, near the beak of one valve are two shelly projections. They fit into two sockets in the other valve. The two processes are called 'teeth' though they have nothing to do with food. The name probably arose from the microscopic ferocity with which they project. Some forms even show the scars where the opening and closing muscles have been attached. In addition, other processes extend from near the beak into the cavity formed by the two valves. To these were attached the cilia-bearing apparatus for bringing in the water with its life-giving oxygen and food. These processes are fairly simple in most of the brachiopods found around here, but have a variety of shapes in later, more highly developed genera. They may be spiral, or forming a loop, or two spirals joined by a transverse bar. *Zygospira*, one of the latter type is found here, but the inner mechanism is rarely revealed.

One of the more primitive brachiopod groups (Plate I, Fig. 4; and Plate III, Fig. 1, 2) opened by a lateral movement, one valve sliding sideway upon the other. Even though more primitive the method seems to have been effective because representatives of the group still survive in the Pacific ocean while only one small group remains of the much more numerous, highly specialized forms.

Brachiopods may be found here in the rocks of every invasion, though they are most prolific in the sediments of the Third Invasion.

PELECYPODA

Clam Types

(Plate III, Fig. 23-33; Plate V, Fig. 5-9)

Like the brachiopods the pelecypods have two shells, or valves. But there the similarity ends. The median line from the beak to the middle of the opposite margin does not divide the shell equilaterally as in the brachiopod, and except in rare cases not found here, the two shells are alike in shape and outline except that one is left and the other right. This can be easily verified by holding a complete individual with the beak pointing away from the observer. In this position the beak, or the part in front of it, is the anterior, and the whole shell is bilateral. The ornamentation is the same on both valves and may consist of concentric growth lines only, with or without striae radiating from the beak, or in other cases, a marked ridge extends from the beak to the posterior end or to the lower margin.

Internally like the brachiopods, they have 'teeth' at the anterior or on either side of the beak. The 'teeth' are of various sizes and shapes and function as a fulcrum upon which to open and close the shell to obtain water for food and oxygen. The muscles for opening are along the hinge line at or on one or both sides of the beak. Contraction of this muscle opens the shell at the opposite margin. The closing muscles are nearer the lower margin (as it is conventionally oriented in all illustrations) and placed towards the anterior and posterior ends, in the same position in each valve.

Pelecypods, like brachiopods, are conventionally illustrated with their beaks up, but this is not the way they live. The beak is in an oblique position, the anterior end being lower than the posterior. Many forms are even attached to the rocks or some stable surface by a muscle from near the beak leaving the opposite margin free to open for taking in water and food.

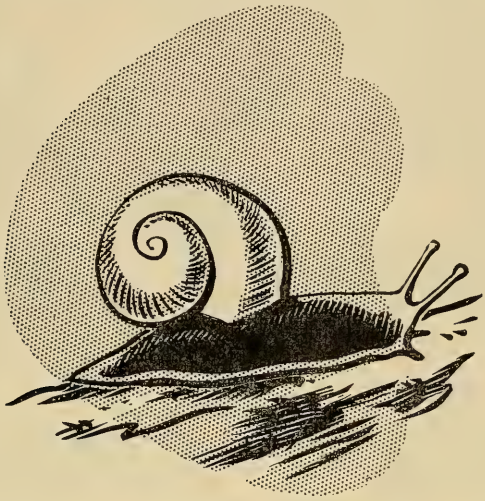
Pelecypods have survived the ages. They are more numerous to-day than they have ever been. Living forms make it easier to interpret the features found on the fossils.

They are not common among the fossils of the First or Second Invasions, but can be found at almost any level of the Third Invasion, though not so numerous as brachiopods. They are fairly common in the Fifth and some are good horizon markers of the Sixth Invasion.

GASTROPODA

Snail Type

(Plate I, Fig. 2, 3; Plate III, Fig. 34; Plate IV, Fig. 1-5)



The common snail is an example of a gastropod. Unlike brachiopods and pelecypods all gastropods have one valve only, and it is usually coiled. The shape of the coil is varied, both in the living and in the fossil forms.

One group, rarely found in these rocks, is a simple cap-shaped form, the initial coil at the top being minute or its place at the top being indicated by an excentric point. Another group is involute, that is coiled in a plane, so that the later growth envelopes the immature coils, completely covering them, or leaving only a small portion visible at the sides. Other forms are asymmetrically coiled, some having a low spire, and some having a high spire. Ornamentation, too, is varied: transverse growth lines, coarse or fine striae revolving with the growth of the shell, or even nodes.

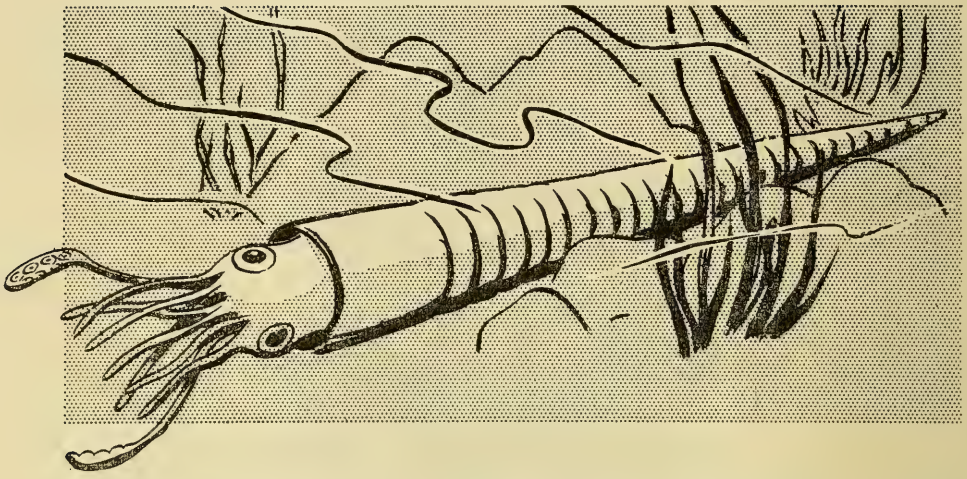
If the fossil is held with the large opening at the base towards the observer it will be seen that most forms have a right-hand coil. A very few coil to the left, one genus of which occurs in the region.

The bivalved brachiopods and pelecypods open and close their valves to obtain water and oxygen. The gastropod pushes his foot out of the large opening at the base of the shell. On top of his foot is his head. In many modern forms on top of his head are two stalked eyes. On top of his back is his shell. Thus he searches for his food. So the gastropod has no need of the mechanism for opening and closing the shell. Some forms, like the left-hand coiled one bear on the foot a small shelly plate, the operculum. When the animal is withdrawn into the shell the operculum on the bottom of the foot closes the opening and protects him.

Gastropod fossils found here are all marine, but there are groups now living in freshwater, and some, like the land snail, live on land, taking their oxygen from the air.

CEPHALOPODA

(Plate IV, Fig. 6-8; Plate V, Fig. 1)



The octopus and the squid are modern cephalopods, though without a shell. Fossil cephalopods have shells or they would not be preserved. The forms, in their long dimension, may be straight, curved, or coiled. In a transverse section they may be circular, elliptical or almost flat. Others are small, slightly curved and swollen at the top. One rather rare coiled form lived in the sea of the Fourth Invasion and is occasionally found in the black shales. But the greatest number in this basin are tapering with straight sides.

Externally cephalopods may be ornamented by longitudinal or transverse ridges or fine striae. A few are fluted.

Whatever their adult shape, or size, or ornamentation they all began in a small initial chamber. Not being able to push out the walls of its little room each individual as it increased in size, added a larger chamber beyond by further secretion of the shell material from its outer skin. As it moved onward into the new and larger room it deposited a floor or septum behind, cutting off a part of the smaller end of the home vacated. Thus chamber after chamber was added. Each living chamber into which it moved was larger and wider than the previous one. Floor after floor covered its past. But, in each case, in the floor or septum an opening was left so that all the deserted rooms, or parts of rooms were connected. In many cases the outside shell layer is destroyed, and the edges of the septa can be seen.

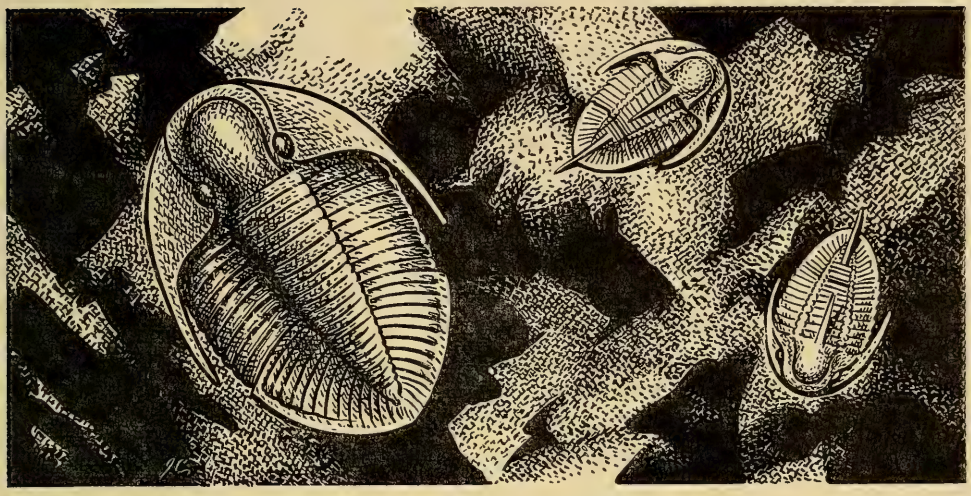
The inner tube that connets all the chambers is called a siphuncle, and it can have a number of shapes. Some are straight, some are nummuloid, that is like a string of beads each segment a round or somewhat flattened bead, of different sizes and shapes in different genera. The sides of the segments or beads are gently curved outward at each chamber contracting a little as the siphuncle passes through the septum.

Cephalopods are most prolific here in the Leray-Rockland beds of the Third Invasion, particularly the forms with the bead-like siphuncles, and the short, curved forms which are swollen in the uppermost living chamber. One tapering form is found quite commonly in the black shales of the Fourth Invasion.

TRILOBITA

Just Trilobites, like nothing else

(Plate IV, Fig. 9-13; Plate V, Fig. 2-4)



Trilobites have been extinct for several hundreds of millions of years, but the environment in which the fossils are found indicates that they were all marine.

The word trilobite comes from the three-fold character of the specimens. The body is divided lengthwise into three parts (trilobed) by two furrows which extend from the front to the posterior: the axial lobe, and two pleural (side) lobes, one on each side of the axial lobe. A few forms have indistinct furrows and are almost smooth. A trilobite is also divided transversely into three parts. It consists of a head (cephalon), a body (thorax), and a tail (pygidium). Each of these parts is composed of a number of segments, varying in the different genera.

The head also consists of three pieces: the cranidium composed of the glabella with the attached fixed cheeks representing the axial lobe, and the free cheeks probably corresponding to the pleural lobes. The segmentation of the cranidium in some genera is revealed in the small furrows on the glabella. Between the fixed and the free cheeks is a suture line which extends to the anterior margin where the sutures from the sides are united. In the other direction the sutures reach the back of the head, or in some turn outward just back of the eye to the margin at the side of the head. Trilobites had a hard chitinous (horny) covering. Like the cephalopod the trilobite could not enlarge itself as it grew. But unlike the cephalopod it shed its shell and grew a larger one. In short, it moulted. It is thought that the suture line skirting the cranidium is the break. Because parts of the head and parts of the tail are fused they withstand weathering better than the thorax. For some reason the tails are usually more often found than the heads. The thorax later generally breaks further into numerous segments. The cranidia are frequently found without the other parts of the head. The eyes are generally on the upper surface of the head on the free cheeks.

Some early forms appear to have been blind. Most trilobites, however, have compound eyes with many facets. The facets may be separate, each protected by cornea, or one cornea may cover all the facets. The under side (ventral side) shows that the margin of the cephalon is turned under forming a rim. From the anterior of it a long plate extends backward covering the mouth. The position of the plate and mouth shows that the trilobite was a scavenger, feeding on the bottom.

The thorax, too, has the three-fold division, the axial lobe and the two pleural lobes. It is composed of transverse segments, each segment fitting into the next in such a manner that when living the creature could roll itself into a ball. The number of segments varies from two to forty-four. The division of these transverse segments is more definitely preserved than in the head and tail. Each segment has a pair of appendages on the ventral side of the body. These appendages, however, are rarely preserved. One noted specimen has been found in the rocks of the Third Invasion near Ottawa. There may be others.

The pygidium varies greatly in size according to the genus. The trilobed characteristic is still maintained in most genera but usually not so marked as in the thorax. The axial lobe may be evident for part of the length only. In some later forms, however, the axial lobe continues and ends in a spine. The pleural lobes, also, in many, are not so clearly marked. The transverse segmentation is evident on most forms of these rocks, though in some it is not always visible right to the posterior. In such cases, also, it gradually disappears near the margins of the pleural lobes.

Some trilobites are ornamented with spines, nodes, and various protuding processes, but most of those in these older rocks have little in that line. One form in the lower part of the Third Invasion, the Pamelia, has a spine on its pygidium. Another form in the black shales of the Fourth Invasion has a spine at the back of its head, another on the third thoracic segment, and another on its pygidium. On the other hand, one group found in these rocks has even lost most of its trilobed character.

Trilobites are rather highly developed forms and yet they are found in the earliest fossil-bearing rocks, sediments which were deposited during the first great invasion of Canada on the east and west of the continent before any invasion here. From where did they come? One would expect more simple forms in those very early rocks. They must have developed in the Precambrian era. Then why do we not find them there? There may be several reasons. It must be remembered how disturbed those Precambrian rocks were, a condition which would not lend itself to the preservation of fossils. Another probable reason is that their ancestors may have had soft bodies, easily obliterated. The outer hard covering may have been a later development.

BALANUS

(Plate V, Fig. 10)

Balanus (a barnacle) belongs to the Crustaceans. Crustaceans for the most part have jointed appendages like the shrimp. Barnacles do not in the least look like other Crustaceans when they are grown up, but when they first hatch from the egg and during the early part of their lives when they are free-swimming they are not so different. After each moult the shape somewhat changes until finally the barnacle attaches itself to something by its flattened base, to a ship, to the piles of a dock, or to a rock. By this time its outer form is completely altered. The basal plate and the side plates are immovable, but when it wishes to get some food two little triangular doors at the top open and out come the tentacles to wave the water in.

Balanus only appears in the later seas, and is found here in the sand and clay beds of the Champlain sea.

GRAPTOLOIDEA

Graptolites

(Plate IV, Fig. 14, 15)

Graptolites are deceiving. They look like small black, serrated stems. In reality they are one of the most advanced of the Invertebrates. Vertebrates have the spinal cord protected by the vertebrae. Some lower forms have a process in front of the mouth and a nerve cord along the back. They are neither true Invertebrates nor true Vertebrates. So they have been named Hemichordata. Some graptolites have been found recently with a suggestive process in front of the mouth, and graptolites are therefore considered to be primitive forms of Hemichordata.

Those we find in this basin are small, flat, black stems with tiny cups opening on one or both sides. The stems are short and very narrow. Each tiny cup overlaps the next and each holds an individual, but as they bud off the central stem the connection is maintained throughout the stem, for it is hollow. Groups of stems, in some cases, were attached to a central bladder to keep them afloat. One large group, the dendroid graptolites, grew out in a branching colony. The branches divided and subdivided. They were strengthened by small transverse dissepiments or rods connecting the branches. Some authorities think that the initial branch was attached to some floating material, and that the colony hung down like a filmy curtain. Other authorities think the initial branch was rooted and that the colony grew up like a tiny bush.

Graptolites are good horizon markers because most of them floated on the surface as plankton with their own bladder-like swimming wings, or were attached to floating algae, and were carried far and wide by the winds and waves. So the forms of any one period were widespread.

We find them here in the black shales of the Fourth Invasion. And, while they are not numerous, they make it possible to say these beds were deposited at the same time as certain beds in the Arctic and beds in Wales and other places equally far apart.

ECHINODERMATA

(Plate IV, Fig. 16-18)

The word Echinodermata means 'spiny skinned.' Anyone familiar with a starfish or a sea urchin will recognize the aptness of the word. All but the most primitive groups of the 'spiny ones' have a radial symmetry with arms in fives or multiples of five. The anal opening, covered by the anal plate, is for the expulsion of waste matter, and is situated between two arms and opposite the middle arm, with two others on each side, when there are five arms. The form, then, is oriented with the anal plate at the posterior and the opposite middle arm the anterior, thus exhibiting a bilateral symmetry. The worm-like larvae of the living echinoderms show that the bilateral system was the first to appear. Recent studies have suggested that the Echinodermata are higher in the scheme of invertebrates than was at first suspected.

CYSTOIDEA AND EDRIOASTEROIDEA

(Plate IV, Fig. 16, 17)

Cystids and edrioasterids are a queer lot. They are the most primitive of the Echinodermata. Some of them never developed the five-armed pattern. They are all extinct leaving no descendant. But the form of the fossils indicates that they were forty-second cousins, or thereabouts, of the crinoids, and the starfish. By and large they are rare, but we have a few here occurring in some of the layers in the Cobourg beds. A number have been found in the quarries, mostly covered over now, off Cambridge Street near Carling Avenue.

Most cystids are flat in one dimension and a bit unpredictable in outline in the other. One end of the cystid comes more or less to a point, in most but not all cases, ending in a stem which may have been attached to the bottom or to something else. They have a mouth at the margin opposite the attachment end, and two or three arms, though the arms vary in number. One of the more advanced forms has five free arms, thus approaching the crinoids. The arms have grooves down their central axis leading to the mouth. The purpose was to direct the food and oxygen-bearing water to the mouth. The outer shell is made up of irregularly arranged angular plates. In some cystid genera the arms are recumbent, partly embedded in the plates beneath. One plate, or a group of plates, covers the anal opening.

Edrioasterids are similar in many ways but on the whole are more advanced and more symmetrical. They are disks attached to the sea-bottom by one side, the mouth and arms being on the upper side. The arms are five in number embedded in the plates and radiating from the mouth. In some genera the arms all whorled anti-clockwise, having the anal plate between two arms. In other genera one arm whorls clockwise and the other four anti-clockwise. The anal plate lies between the two arms that turn towards one another, an approach to the bilateral symmetry.

CRINOIDEA

(Plate IV, Fig. 18)

Crinoids have living descendants in some places in the Mediterranean Sea. At first the fossils were thought to be plants and were called sea lilies because of their radial symmetry with their long, slender, tentacled arms gently swayed by the movement of the water. But crinoids are living creatures, about second cousins to the sea urchins and the starfish. To visualize a crinoid as it lived think of a starfish. A starfish has its mouth down. In your mind's eye attach a stem to what is now the upper surface of the starfish. Reverse the creature and attach the other end of the stem to the seafloor. The mouth and the arms are now directed upward. This is the position of the crinoid. The crinoid, however, differs from the starfish in many ways. Its arms are free above. Like all Echinodermata the outer frame is made up of plates.

Most fossil forms had a long stem-like attachment composed of bead-like plates strung end to end through a hole in the centre of each plate. The lower end was attached to the seafloor. Some even had processes projecting like roots. The present crinoids have very similar stems but they float unattached. At the upper flower-like end the soft parts of the body are enclosed in the 'calyx,' as it is called. It is made up of protective plates and usually is globular in shape. It varies greatly in size and in the number of plates. At the top of the calyx is an anal plate, covering the opening for the ejection of waste matter, or in some cases it takes the form of a long tube of irregular plates with the anal plate at the end. On the top of the calyx are the mouth plates around which are the arms, always in fives or branching into multiples of five. A groove runs lengthwise down the arms to the mouth, a passage for the food-bearing water.

The creature moved with the undulating water gathering it in by the tentacles, thence the water passed down the grooved arms to the mouth to absorb food and oxygen, and then the waste water passed out through the anal plate. Its bead-like stem gave it a wider range than it would have had if attached by the base of the calyx.

ACKNOWLEDGEMENT

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ALICE E. WILSON.

EXPLANATION OF PLATES

(Except where stated otherwise, figures are natural size.)

PLATE I

First to Third Invasion

FIRST INVASION

FIG. 1. *Scolithus canadensis* (Billings), supposed to be a worm boring, occurring in some places in the Nepean sandstone (p. 53).

FIG. 2. *Raphistomina canadensis* (Billings), from the March beds, lot 3, con. IV, Oxford tp., Ontario. The lower side of a gastropod (p. 57).

FIG. 3. *Ecculiomphalus disjunctus* (Billings), from March beds, lot 3, con. IV, Oxford tp., Ontario. The upper side of a gastropod (p. 57).

FIG. 4. *Lingulepis acuminatus* (Conrad). A reprint. It has been found south of Eagleson's Corners, in Nepean or March beds. A brachiopod (p. 55).

SECOND INVASION

FIG. 5, 6. *Hebertella pulchella* Wilson, Fig. 5 × 2, found in the limestone beds of the St. Martin (p. 55). These specimens came from Barnhart Island near the power dam. The same forms may be found east of Ottawa. A brachiopod (p. 55).

FIG. 7, 8. *Camarotoechis plena* (Hall), showing both sides of one specimen. Fig. 7 has a fold and Fig. 8 has a complementary hollow or sinus. Compare the shape of the beak with that of *Hebertella*. A brachiopod (p. 55).

THIRD INVASION

FIG. 9. *Stelliella billingsi* Hinde, from Cobourg beds on Booth Street, Ottawa. A complete sponge (p. 48).

FIG. 10. *Stelliella ottawaensis* Wilson, from Cobourg beds on Booth Street, Ottawa. A cross section of another species of the same genus, showing the central cavity and a section of the canals (p. 48).

FIG. 11. *Stelliella crassa* Hinde, × 10, from an unspecified locality at Ottawa, probably from Cobourg beds, showing the siliceous spicules for support of the soft parts (p. 48).

FIG. 12. *Licrophycus ottawaensis* Billings, × 4/5, from an unspecified locality at Ottawa, probably from Cobourg beds. It is thought to be an alga, a low form of plant life (p. 47).

PLATE II

Third Invasion — Continued

FIG. 1. *Receptaculites occidentalis* Salter, from Leray-Rockland beds at Rockland, Ontario. One of the forms of uncertain affinities thought to be near the sponges (p. 49).

FIG. 2. *Stromatocerium rugosum* Hall, from Leray-Rockland beds at Paquette Rapids, Ottawa River. Another orphan. Its affinities not certain, but thought to be near the modern Hydrozoa (p. 50).

FIG. 3. *Lambeophyllum profundum* (Conrad), from Leray-Rockland beds at Paquette Rapids, Ottawa River. A simple coral more or less horn-shaped (p. 51).

FIG. 4. *Streptelasma corniculum* Hall, occurring from the Lowville beds right up to the Cobourg beds, in any exposures. Another simple horn-shaped coral, showing a longitudinal section of the interior (p. 51).

FIG. 5. *Calapoecia canadensis* Billings, from Leray-Rockland beds at Pakenham, Ontario. A coral colony having many pores in the walls of the corallites (p. 51).

FIG. 6. *Tetradium fibratum* Safford, occurring from the Pamelia to the Rockland beds. A coral colony common at Pakenham and at Rockland, Ontario (p. 51).

FIG. 7. *Tetradium fibratum* Safford, a cross section, × 5.5, occurring at Pakenham and at Rockland, Ontario. A coral colony showing the walls penetrating the interior of the corallite. If the walls had reached one another four new corallites would have been formed from each corallite (p. 51).

FIG. 8. *Lyopora halli* (Nicholson), from Leray-Rockland beds at any exposure. A coral colony showing the tabulae across the corallites. This form lacks the pores seen in Fig. 5 (p. 51).

FIG. 9. *Conularia trentonensis* Hall, from an unspecified locality near Vankleek Hill, possibly from Cobourg (?) beds or loose. Another orphan group. Showing the pyramidal shape and the ornamentation (p. 52).

FIG. 10. *Lechthalyus ? curiosus* Wilson, × 3, from Cobourg beds at Lydia and Rochester streets, Ottawa. A supposed worm case (p. 53).

FIG. 11. *Prasopora* sp. from Sherman Fall beds at any exposure, showing the general form. A bryozoan (p. 54).

FIG. 12, 13. *Prasopora grandis* (Ulrich), × 10, occurring as in Fig. 11. Fig. 12, a longitudinal section showing diaphragms and cysts along the zooecia. Fig. 13, a transverse section showing the circular zooecia and cutting some of the cysts irregularly (p. 54). A bryozoan.

FIG. 14, 15. *Escharopora frondosa* Wilson, × 10, from Leray-Rockland beds at Rockland. Fig. 14 shows an enlarged polished section of the zooecia of one side. Fig. 15 shows a longitudinal section at right angles to Fig. 14, revealing the zooecia extending out from each side of a thin dividing plate. A bryozoan (p. 54).

FIG. 16. *Hemiphragma tenuimurale* Ulrich, × 10. A reprint, showing a longitudinal section of a round branching bryozoan (p. 54).

FIG. 17, 18. *Rhynidictya* sp. Reprints; occurring from Leray-Rockland beds to Cobourg beds, at any exposure, showing the imperforated edges of a thin branching form. Fig. 17 × 10, Fig. 18 nat. size. A bryozoan (p. 54).

PLATE III

Third Invasion — Continued

Fig. 1 to 22 are brachiopods (p. 55). Note the similarities and the differences in the size, hinge line and ornamentation.

FIG. 1. *Lingula cobourgensis* Billings, from Cobourg beds wherever exposed. This is one of the more primitive forms that opens sideways.

FIG. 2. *Lingula briseis* Billings, from Cobourg beds at the corner of Lydia and Rochester streets, Ottawa. It also occurs in the Sherman Fall beds.

FIG. 3. *Pholidops trentonensis* Hall, from Val Tetreau, occurring anywhere from the Hull to the Cobourg beds.

FIG. 4. *Platystrophia amoena longicardinalis* McEwan, from Leray-Rockland beds, also found up to the Cobourg beds.

FIG. 5. *Sowerbyella sericea* (Sowerby), found from Lowville to Cobourg beds in any locality.

FIG. 6. *Resserella rogata* (Sardeson), occurs anywhere from Lowville to Cobourg beds.

FIG. 7. *Plectorthis plicatella laurentina* Wilson, from Cobourg beds at the Research Council Laboratories, Sussex Street, Ottawa. It is also found in Sherman Fall beds.

FIG. 8, 9. *Doleroides pervetus ottawanus* Wilson, occurs anywhere in Leray-Rockland beds.

FIG. 10, 11. *Hesperorthis tricenaria* (Conrad), occurs anywhere in Leray-Rockland beds and recurs in Cobourg beds.

FIG. 12, 13. *Glyptorthis bellarugosa* (Conrad), occurs anywhere in Leray-Rockland beds. This specimen from Rockland quarry. Note in Fig. 12 the small projections with sockets behind them, and the small straight plate between them. The latter is the place of attachment for one end of the opening muscle. In Fig. 13 note the rugose ornamentation.

FIG. 14. *Rafinesquina alternata* (Conrad), occurs anywhere from the Leray to the Cobourg beds.

FIG. 15. *Rafinesquina deltoidea* (Conrad), occurs anywhere in Sherman Fall and Cobourg beds. It even returned early in the Fourth Invasion. Note the way in which the margins bend as compared with the flatter *Rafinesquina alternata*.

FIG. 16. *Dinorthis iphigenia* (Billings), from an unspecified locality. It occurs anywhere in Rockland to Cobourg beds.

FIG. 17, 18. *Rhynchotrema increbescens* (Hall), from Leray-Rockland beds, Merivale Road, Ottawa. It occurs anywhere from Lowville to Cobourg beds. Fig. 18 is × 4 to show the long internal prongs to which is attached the feathery lophophore that produces the current to bring in the food- and water-bearing water. This specimen is from Leray-Rockland beds at Paquette Rapids, Ottawa River.

FIG. 19, 20. *Zygospira recurvirostris* (Hall), × 3, from Hull or Sherman Fall beds, Brewery Creek, Hull, Quebec. It occurs anywhere from Lowville to Cobourg beds.

FIG. 21, 22. *Cyclospira bisulcata* (Emmons), × 2, from Sherman Fall beds behind the old axe factory, Hull, Quebec. It may occur in Sherman Fall or Cobourg beds.

* * *

Fig. 23 to 33 are pelecypods (p. 56). Note the lack of bilateral symmetry and that they have equal valves except that one valve is right and the other left, a feature shown in Fig. 30.

FIG. 23. *Cyrtodonta subcarinata* Billings, a right valve from Leray beds at Pointe Claire, Quebec. It occurs anywhere in Lowville or Leray beds.

FIG. 24. *Cyrtodonta huronensis* Billings, left valve, may occur at any exposure of Lowville or Leray beds.

FIG. 25. *Cyrtodonta canadensis* Billings, left valve, from Leray-Rockland beds at Paquette Rapids, Ottawa River. It may occur anywhere in Leray or Rockland beds.

FIG. 26. *Orthodesma decorosum* Wilson, left valve, from Pamelia beds in Ramsay tp., Ontario. Note the protuberance on the anterior of the shell, a scar where one of the muscles was attached.

FIG. 27, 28. *Ctenodonta gibberula* Salter, right valve, from Leray-Rockland beds on Allumette Island, Ottawa River, Quebec. Fig. 27 from the exterior; Fig. 28 from the interior, showing the hinge with the scars of the place of attachment of the anterior and posterior muscles for closing the shell, also the row of 'teeth' and sockets. The 'teeth' are not used for eating but as a fulcrum for opening and closing.

FIG. 29, 30. *Ctenodonta nasuta* Salter, from Leray-Rockland beds, Allumette Island, Ottawa River, Quebec. Fig. 29, right valve, showing the long anterior projection; Fig. 30, showing the two valves and the hinge line. Note the slight turn of the beak indicating which is the anterior. The form occurs from Pamelia to Cobourg beds.

FIG. 31. *Vanuxemia canadensis* Wilson, right valve, from Hull or Sherman Fall beds, about 4 miles west of L'Orignal, Ontario. It occurs anywhere from Leray to Sherman Fall beds.

FIG. 32, 33. *Vanuxemia inconstans* Billings, from Leray beds at the Fourth Chûte of the Bonnechère River, Ontario. Fig. 32, right valve, from the exterior; Fig. 33, left valve, from the interior, showing the 'teeth' or fulcrum. Compare this type of 'teeth' with those of Fig. 28. The form occurs anywhere in Leray or Rockland beds.

* * *

GASTROPODA

Note the difference in direction of the coil of this gastropod and those in Fig. 1 to 5 on Plate IV (p. 57).

FIG. 34. *Maclurites logani* (Salter), from Leray-Rockland beds at Paquette Rapids, Ottawa River. Note the left-hand coil when the opening faces the observer. Compare with Fig. 1 to 3 on Plate IV. Also note the operculum, the small shell attached to the foot closing the opening when the creature is withdrawn into its shell home. The form may occur anywhere in Leray or Leray-Rockland beds, and it recurs in Cobourg beds.

PLATE IV

Third Invasion — Concluded

GASTROPODA — Continued

Fig. 1 to 5 are gastropods. Note the direction of the coil. Fig. 1 to 3 are right-hand coils when the opening faces the observer. Fig. 4 and 5 are coiled in a plane, that is, each coil is directly over the preceding one and partly envelopes it (p. 57).

FIG. 1. *Trochonema umbilicatum canadense* Ulrich and Scofield, from Leray-Rockland beds at Paquette Rapids, Ottawa River. Note the angular shoulders and the shape of the opening. The form occurs anywhere in Leray or Rockland beds and recurs in the Cobourg beds.

FIG. 2. *Hormotoma bellicincta* (Hall), from Leray-Rockland beds at Paquette Rapids, Ottawa River. Note the compactness of the whorls. It occurs anywhere from the Lowville to Cobourg beds.

FIG. 3. *Hormotoma trentonensis* (Hall), from Cobourg beds at the west end of Fifth Avenue, Ottawa. It occurs in the Sherman Fall and Cobourg beds.

FIG. 4, 5. *Phragmolites compressus* Conrad, from Leray-Rockland beds on Allumette Island at Paquette Rapids, Quebec. Note the central revolving rib and the ornamentation on the sides. It occurs in Leray and Rockland beds.

* * *

CEPHALOPODA

Fig. 6 to 8 belong to the cephalopods (p. 58).

FIG. 6 *Gonioceras occidentalis* Hall. A reprint, showing the sudden change in the direction of the sutures on the right side. A corresponding change occurs on the left when it is preserved. It occurs anywhere in Leray or Rockland beds.

FIG. 7. *Actinoceras* cf. *bigsbyi* Bronn. A reprint, a small piece of a large form cut down the centre to show the interior of the septa, the broad bead-like siphuncle connecting the initial chamber with the living chamber, and the central cavity—the white part, piercing the siphuncle. It occurs anywhere in Leray and Rockland beds.

FIG. 8. *Ormoceras allumettense* (Billings), from Leray-Rockland beds at Paquette Rapids, Ottawa River, showing the interior with septa and bead-like siphuncle connecting the initial and living chamber. It occurs from the Pamelia to the Leray-Rockland beds.

* * *

TRILOBITA

Fig. 9 to 13 are trilobites (p. 59).

FIG. 9. *Isotelus ottawaensis* Wilson, showing the rounded anterior and a broken posterior, but not showing the longitudinal trilobation as clearly as Fig. 10, from Cobourg (?) beds from an unspecified locality at Ottawa, Ontario.

FIG. 10. *Flexicalymene senaria* (Conrad). A reprint, showing the longitudinal trilobation, the parts of the cephalon (head), the thorax (body), and the pygidium (tail). It occurs at any exposure from the Leray to the Cobourg beds.

FIG. 11. *Bumastus milleri* Billings, from Leray-Rockland beds near L'Orignal, Ontario, showing a faint longitudinal trilobation, the complete thorax and tail, but part of the head concealed by rolling. It occurs from the Pamelia to the Rockland beds.

FIG. 12. *Bathyurus trispinosis* Wilson, from Leray beds at Pakenham, Ontaria, showing the large tail spine, but it has three smaller spines on the back of the head.

FIG. 13. *Bathyurus extans* (Hall), from Leray beds near L'Orignal, Ontario, showing the trilobation and segments of the tail. It can be found in both Pamelia and Lowville beds.

* * *

GRAPTOLOIDEA

Fig. 14, 15 are graptolites (p. 61).

FIG. 14. *Diplograptus amplexicaulus* cf. *pertenius* Ruedemann, × 8, from Cobourg beds, Rochester Street, Ottawa, showing the sicula of the initial theca (cup) and the sharp spine-like edge of the theca.

FIG. 15. *Climacograptus inuiti similis* Wilson, × 6, from Cobourg beds at the National Research Council Laboratories, Sussex Street, Ottawa, showing the horizontal top of the cup, the straight sides, and the spine at the base of each cup.

* * *

ECHINODERMATA

FIG. 16-18 each belong to one of three different types (p. 62).

FIG. 16. *Lepidiconia lorifrons* Raymond, an edrioasterid from the Cobourg beds from an unspecified locality at Ottawa, showing the anti-clockwise turn of the arms.

FIG. 17. *Amygdalocystites florealis* Billings, a cystid from Cobourg beds on Booth Street, Ottawa, showing its irregular but ornamented plates.

FIG. 18. *Cremacrinus inaequalis* (Billings), a crinoid from an unspecified locality at Ottawa, showing the free arms (p. 63).

PLATE V

Fourth to Final Invasion

FOURTH INVASION

FIG. 1. *Geisonoceras* sp. a cephalopod (p. 58), occurring anywhere in the Eastview formation, and in the lowest part of the Billings formation. They are usually poorly preserved in the black shales and frequently they are coated with pyrite.

FIG. 2. *Ogygites latimarginatus* (Hall), a trilobite (p. 59), showing the longitudinal trilobation well. Tails of this form are often very numerous, occurring anywhere in the Eastview formation.

FIG. 3, 4. *Triarthus spinosus* Billings, a trilobite (p. 59), from an unspecified locality in Gloucester tp., Ontario, the head only, showing the one head spine.

FIFTH INVASION

No fossils are illustrated from the Fifth Invasion. There are not many in this district. Some very poorly preserved specimens of Pelecypoda have been found at one exposure in the bed of a creek near the red church south of Hawthorne, Ontario.

SIXTH INVASION

FIG. 5. *Byssonychia radiata* Foerste, × 1½, a reprint of a pelecypod. The rocks of the invasion are only sparsely exposed in the area, but some loose specimens may be found in the north bank of the North Castor River at the bridge about 2 miles west of Russell, Ontario (p. 56).

SEVENTH INVASION

This is represented by the red shales north of Russell, Ontario (p. 10). Until recently no fossils were found in it. The forms, brachiopods, bryozoans, and ostracods have not yet been worked out.

FINAL INVASION

It will be remembered that the Second Erosional Period of several hundreds of million years (p. 16) occurred after the Seventh Invasion, followed by the advance of the glaciers. As the glaciers retreated the continent was slow in emerging and the sea again invaded from the east.

FIG. 6. *Mytilus edulis* Linnaeus, a pelecypod (p. 56) occuring in the sands of the Champlain sea at the Foster sandpit near Uplands, Ottawa, Ontario.

FIG. 7. *Yoldia arctica* Gray, a pelecypod from the unconsolidated sediments of the Champlain sea. This particular specimen came from Pointe Claire, Quebec.

FIG. 8. *Hiatella (Saxicava) arctica* Linnaeus, a pelecypod from the sandpits at Uplands, Ottawa.

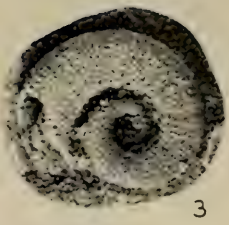
FIG. 9. *Macoma balthica* (Linnaeus), from the sandpits at Uplands, Ottawa, also a pelecypod.

FIG. 10. *Balanus crenulatus* Bruguiere, a barnacle (p. 61) from the sandpits near Uplands, Ottawa, Ontario.





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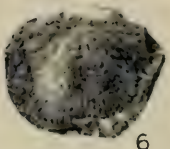


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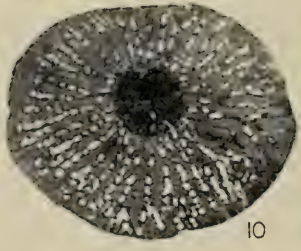
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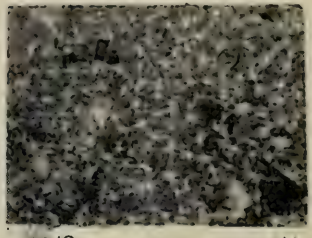
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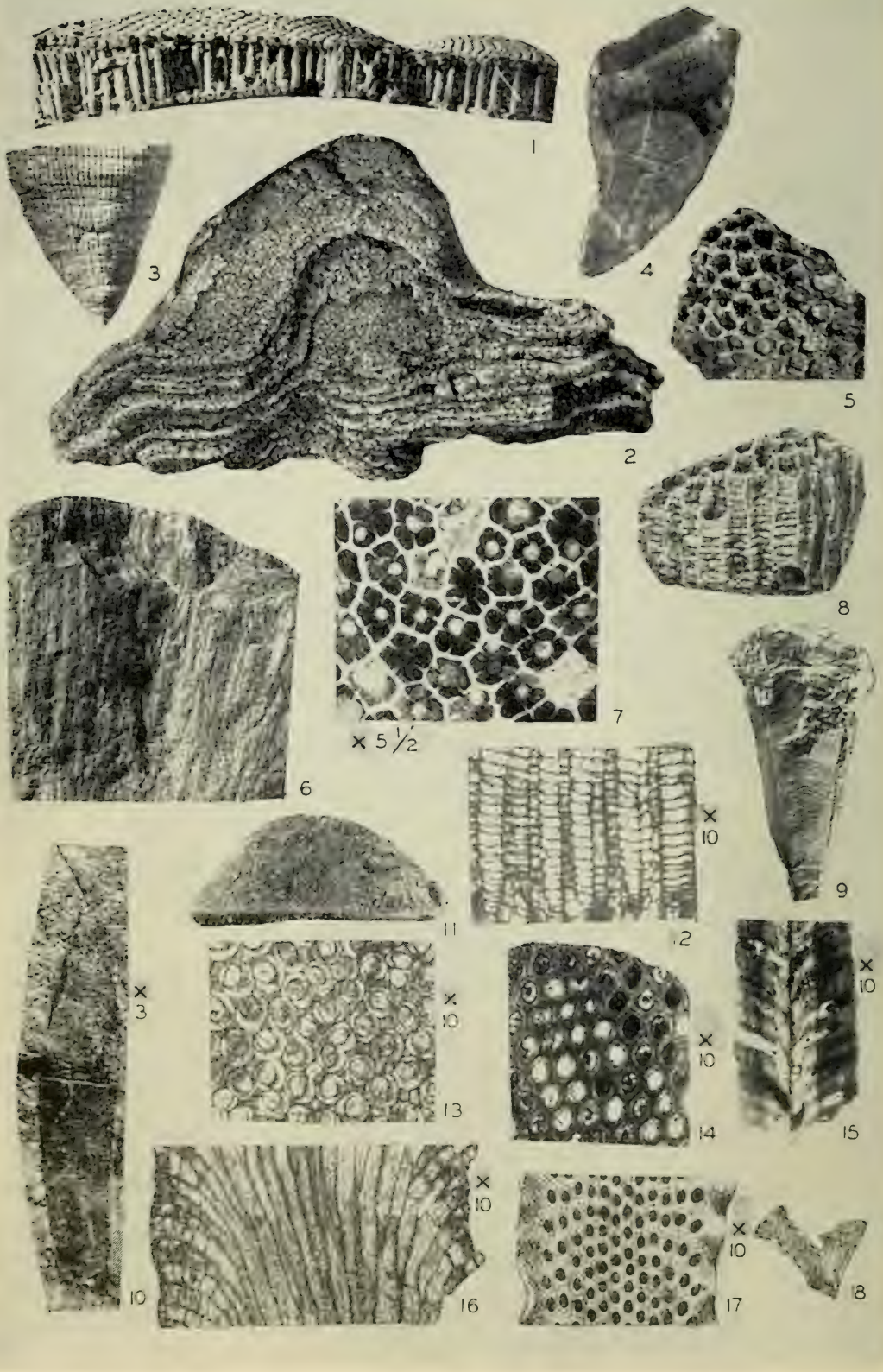
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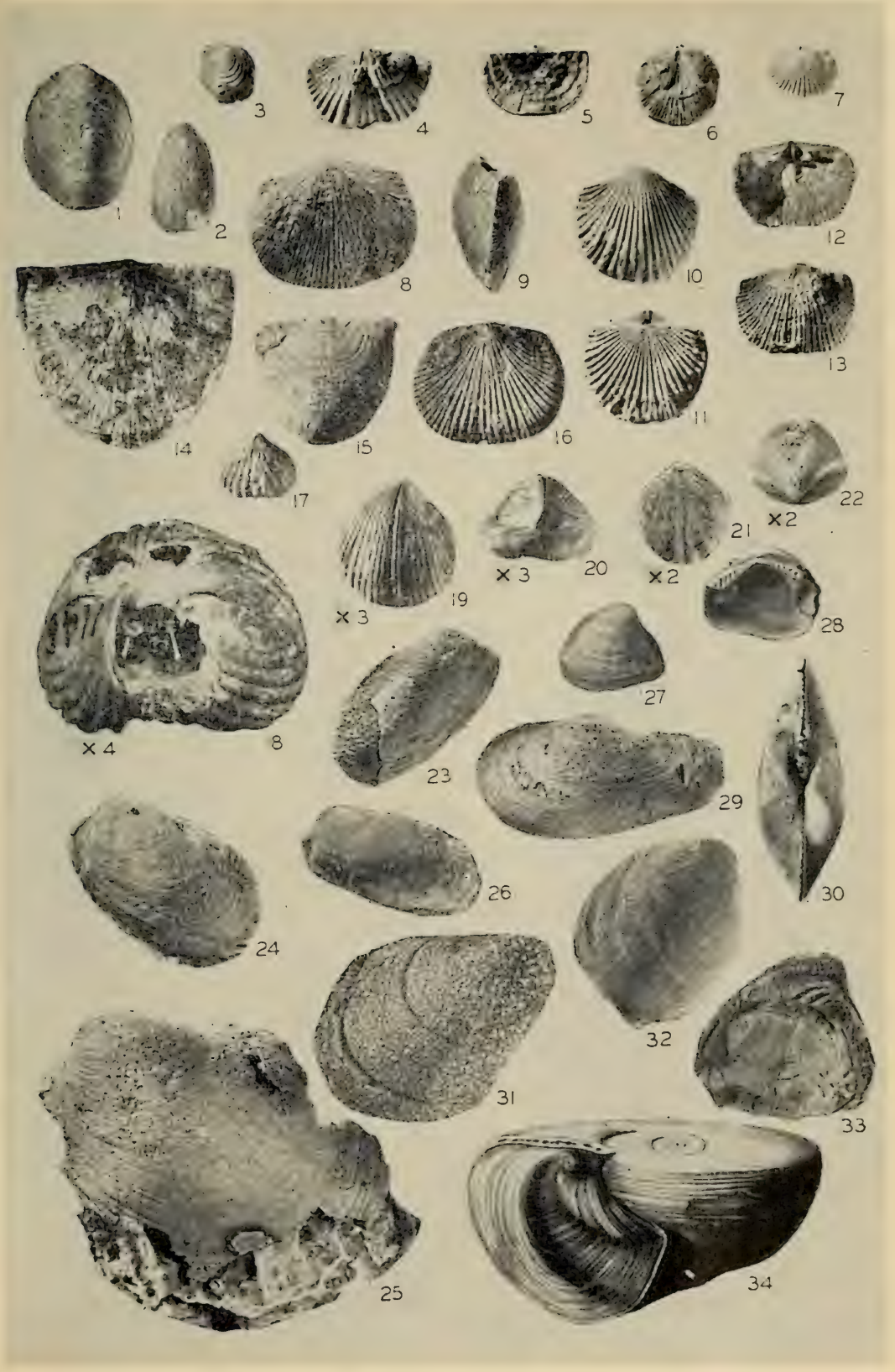
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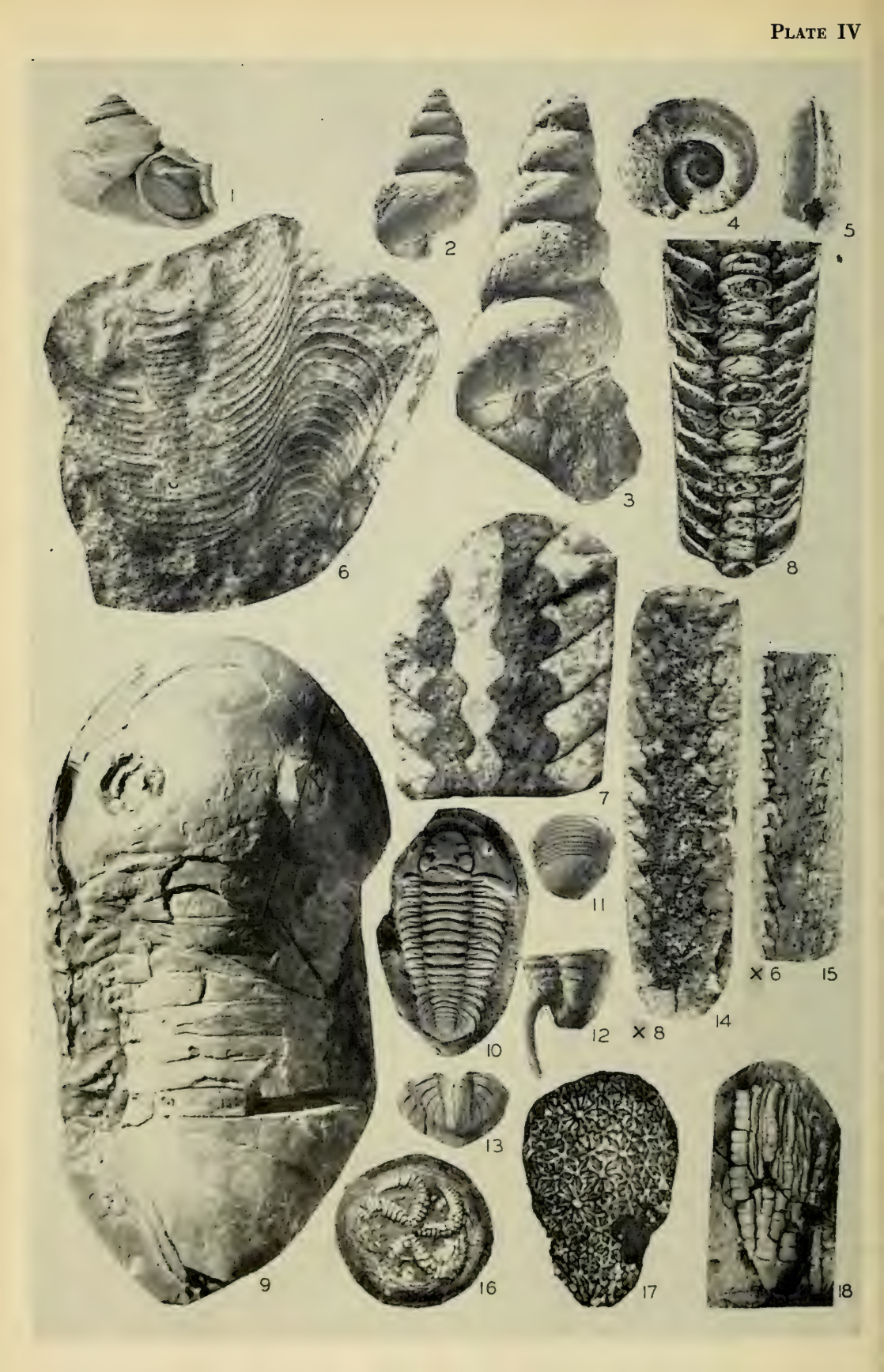


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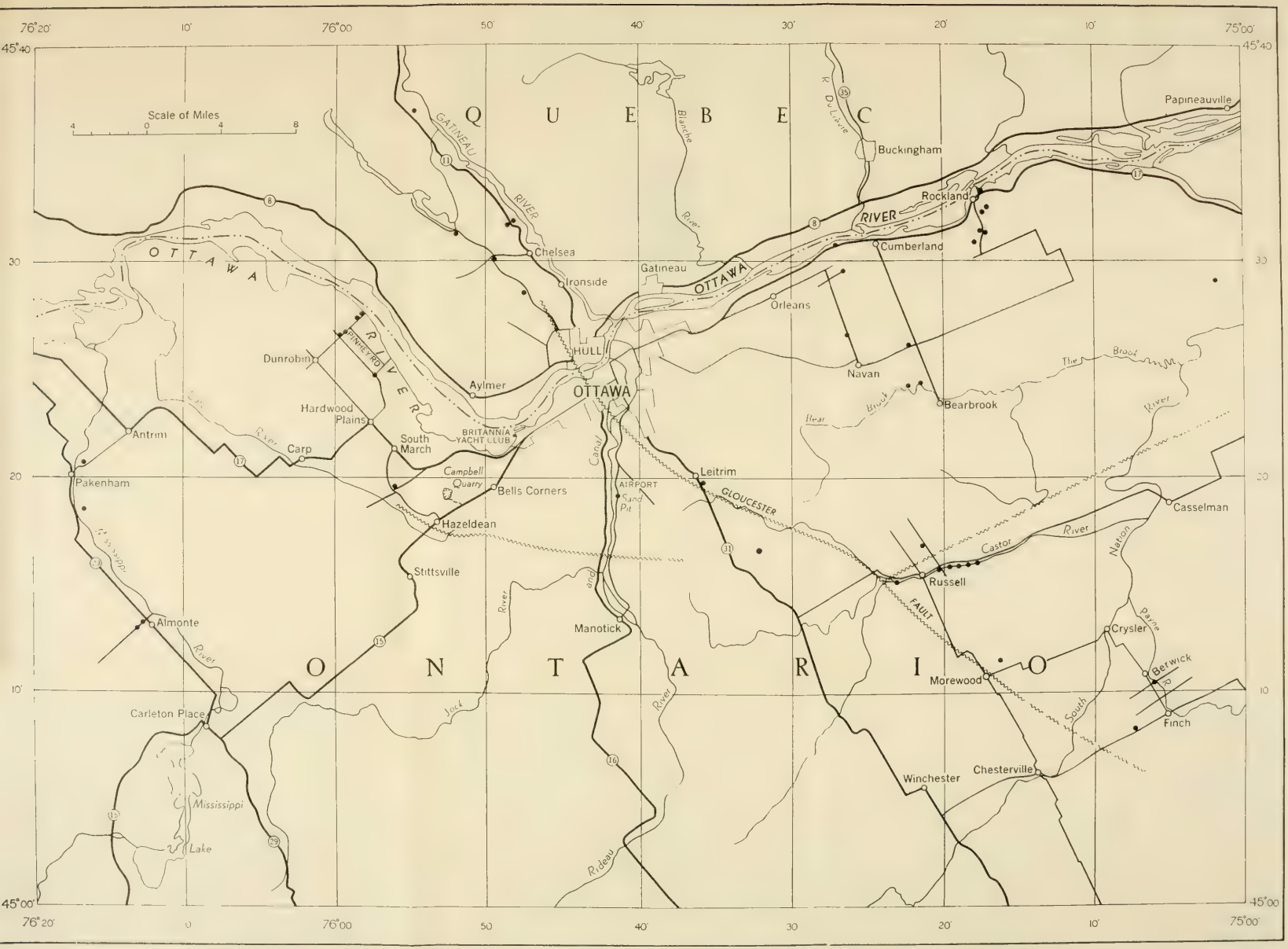
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Route Map of Geological Excursions around Ottawa.

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The CANADIAN FIELD-NATURALIST

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OTTAWA ONTARIO

THE OTTAWA FIELD-NATURALISTS' CLUB

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BIRD AND MAMMAL NOTES FROM THE INTERIOR UNGAVA PENINSULA

CARL R. EKLUND

U.S. Fish and Wildlife Service, Atlanta, Georgia

Received for publication July 29, 1955

During the summer of 1949 a study was made of the interior Ungava Peninsula in northern Quebec for the purpose of determining waterfowl-species distribution and productiveness. The study was part of the annual co-operative survey of waterfowl breeding grounds conducted jointly by the Canadian Wildlife Service and the U.S. Fish and Wildlife Service, as reported by Crissey, *et al.* (1949). The survey was undertaken in co-operation with the Arctic Institute of North America and was financed by a grant from the Institute with funds provided by the United States Government. The field party consisted of Leon D. Cool, former Game Management Agent-Pilot of the Fish and Wildlife Service, and the writer.

A limited collection of 65 bird skins representing 21 species, and 33 mammal skins and skulls of 4 different species was made, incidental to the waterfowl survey. I am indebted to Dr. John Aldrich and Allen J. Duvall of the Fish and Wildlife Service for help in identification of the bird specimens, and to Dr. David Johnson and Charles Handley, Jr. of the U. S. National Museum for examination of the mammals. Food habits of the waterfowl collected have been reported upon by Polunin and Eklund (1953).

The field work was carried out between June 29 and August 3, 1949. A single-engine Fairchild 24 airplane equipped with pontoons was used. The main bases of operation were the military air base known as "Crystal I", on the Koksoak River near Fort Chimo, and Payne Lake, in the interior at Latitude 59° 19′ N., Longitude 73° 27′ W. The U. S. Air Force parachuted oil and gasoline at our base on Payne Lake. This enabled most of the aerial transects to be run from this point, and permitted fairly extensive coverage of the peninsula.

Studies were confined generally to that portion of the peninsula south of Hudson Strait between Hudson Bay and Ungava Bay. Primary emphasis was placed on the interior of the region, where biological investigations have been extremely limited. Aerial transects were also flown, however, in the tidal areas, and in the interior south and southeast of the peninsula as defined. This region has two major habitat types — tundra and forest-tundra. The tundra region lies generally northward of the middle and eastern portions of the Leaf River, while the forest-tundra extended northward from our southernmost station at Lake Aigneau at Latitude 57° 11′ N., to between Latitude 59° and 59° N.

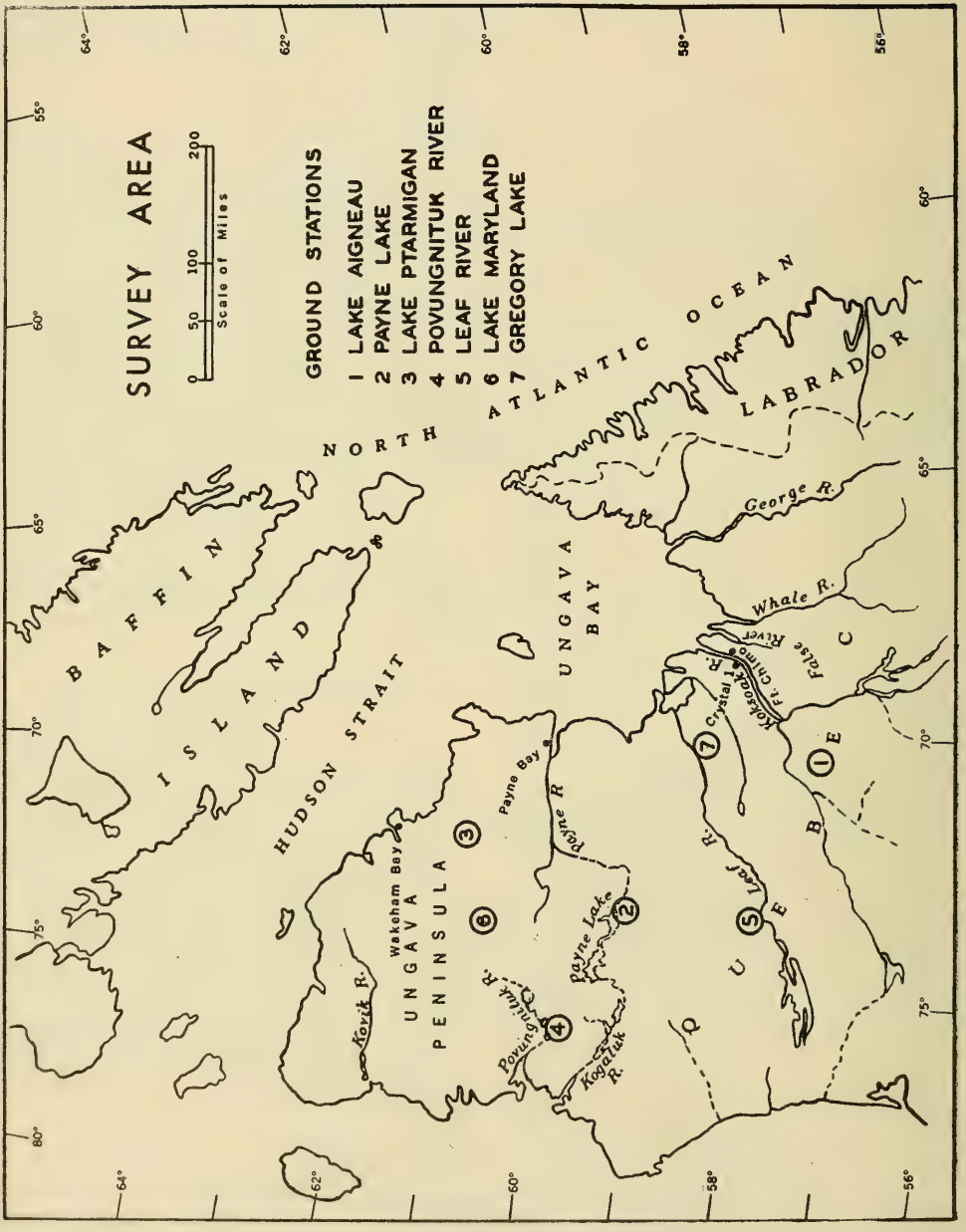
DESCRIPTION OF COLLECTING STATIONS

Collections of birds and mammals were made at seven ground stations in the interior (see map of Survey Area), as well as along the coast at Payne Bay Hudson Bay Post, Diana Bay and Wakeham Bay. No bird notes are included from the coastal areas, however, since considerable studies have already been made here and our observations were quite limited. This paper is concerned with observations and collections at the following locations as shown on Air Navigation Maps, National Topographic Series (8 miles to the inch), published by the Canada Department of Mines and Resources:

LAKE AIGNEAU — Latitude 57° 11′ N., Longitude 70° 09′ W.

A camp was occupied July 1 and 2 at the south end of the lake near the river's inlet. According to the classification of Hustich (1949), the lake lies in the forest-tundra, and

The Canadian Field-Naturalist for January-March (Can. Field Nat. 70 : 1-68. 1956) was issued March 25, 1957


SURVEY AREA
Scale of Miles
0 50 100 200
GROUND STATIONS
1 LAKE AIGNEAU
2 PAYNE LAKE
3 LAKE PTARMIGAN
4 POVUNGNITUK RIVER
5 LEAF RIVER
6 LAKE MARYLAND
7 GREGORY LAKE
NORTH
BAFFIN
ISLAND
HUDSON STRAIT
ATLANTIC OCEAN
LABRADOR
UNGAVA BAY
PENINSULA
UNGAVA
Wakeham Bay
Payne Bay
Payne R.
Payne Lake
Povungnituk R.
Kogaluk R.
Koroc R.
Leaf R.
Crystal R.
Kokoroot Fl.
Falcon River
Whale R.
George R.
QUEBEC
80°
75°
70°
65°
60°
55°
64°
62°
60°
58°
56°

is characterized by black spruce, larch, willow, and alder occurring in patches and along water edges. Higher portions of the ground were barren. This was the most heavily wooded of all the areas visited.

PAYNE LAKE — Latitude 59° 19′ N., Longitude 73° 27′ W.

This was our advance base for flight transects and we maintained a camp intermittently from July 8 to 27 on a sand beach on the east end of the lake at the outlet of the Payne River. This area was apparently a favorite camping spot for the Payne Bay Eskimos as was evidenced by numerous tent rings. There was no evidence of recent usage. We observed at the river oulet what appeared to be goose blinds, consisting of blocks of mosses and lichens piled in walls.

Payne Lake is the largest of the Ungava lakes within the tundra region, as defined, and the vegetation on the surrounding terrain is characterized by plants such as mosses, lichens (principally *Cladonia),* sedges *(Carex* spp.), willow, dwarf birch *(Betula glandulosa),* bake-apple or cloudberry *(Rubus chamaemorus),* Labrador tea *(Ledum* spp.), and blueberry *(Vaccinium uliginosum* var. *alpinum).* Ground elevations are under 800 feet, and the terrain is gently undulating.

LAKE PTARMIGAN — Latitude 60° 46′ N., Longitude 71° 47′ W.

This is an unofficial name for our most northerly interior station which we occupied at the southeast end of a four-mile long lake, from July 16 to 18. Camp was established approximately 30 miles southeast of Hudson Strait. The terrain is hilly, and more exposed rock was in evidence here than at any of the other camp sites.

Mosses, lichens, and Labrador tea were dominant, and other plants such as alpine holy-grass *(Hierochloe alpina),* tall cotton-grass *(Eriophorum angustifolium),* sedges, and blueberry were among the more common species. Aquatic plants seemed entirely lacking.

POVUNGNITUK RIVER — Latitude 59° 51′ N., Longitude 76° 12′ W.

We landed on a two-mile long lake through which the river flowed, and made collections for only several hours on July 21. Where the river flowed out of the lake we observed several thousand Arctic charr breaking the smooth water surface. Below this point there is a fall in the river of some 15 to 20 feet. Vegetation is typical of the tundra and relatively dense in comparison to the Lake Ptarmigan area. The terrain is more rugged than that at Payne Lake, and the shore along the river much sandier than along most Ungava lakes and rivers which we saw.

LEAF RIVER — Latitude 57° 46′ N., Longitude 73° 07′ W.

Landing on a wide section of the river where there was little current, we collected and observed during the afternoon of July 25. This is a typical forest-tundra with fairly thick stands of black spruce, larch, willow, and alder along the river edge, thinning gradually toward the higher land. The terrain is rolling. A common aquatic plant found in a shallow pond off the river was buckbean *(Menyanthes trifoliata),* and from the number that had been pulled up it appeared the geese might have been feeding on this perennial herb.

LAKE MARYLAND — Latitude 60° 27′ N., Longitude 73° 20′ W.

This is an unofficial name for a lake, near Klotz Lake, on which we landed on July 26. Observations and collections were made at the east end of the lake near an outlet of a tributary of the North Payne River. We observed a number of tent rings indicating the site was a favorite camping spot for Eskimos.

The elevation of the area is between 500 and 800 feet, and the terrain is more rugged than that of any other site visited. There is considerable exposed rock, comparable to the Lake Ptarmigan region. Common plants included the usual mosses and lichens, rigid sedge *(Carex bigelowii),* Richardson's anemone *(Anemone richardsoni),* bake-apple, Arctic wintergreen *(Pyrola grandiflora),* white heather, blueberry, and rock or mountain cranberry *(Vaccinium Vitis-Idaea* var. *minor).* Alpine holy-grass is common on the dry higher areas.

GREGORY (OCTOPUS) LAKE — Latitude 58° 29′ N., Longitude 70° 06′ W.

On July 27, enroute from Payne Lake to Fort Chimo we were forced down at Gregory Lake due to a heavy fog coming in from Ungava Bay. As the result, we spent six hours collecting along the lake shore. Polunin (1949, p. 127) and his party spent some time in this area in 1946. He called it Octopus Lake. This was our most northern forest-tundra site.

BIRDS

No attempt has been made to review all the literature on the birds of this region. As implied previously, very limited ornithological work has been carried out in the interior, particularly in the tundra. W. E. Clyde Todd has conducted considerable field work in the southern and western parts of the peninsula and his material is in the process of being published. Manning (1949) collected birds along the east coast of Hudson Bay as well as in some interior portions of western Ungava. His paper includes an excellent resume of previous ornithological investigations in the Ungava area. Extensive studies have been made by Turner (1885) especialaly at Fort Chimo, and by Hantzsch (1908) in the region near Killinek (Port Burwell), Labrador. Hildebrand (1950), and Gabrielson and Wright (1951) have published on observations in the Ungava Bay region, principally in the vicinity of Fort Chimo, George River, and False River. These are but a few of the publications, most of which pertain to the coastal sections.

The following birds were recorded at the interior stations described. In addition to specimens collected, sight records, including aerial observations of waterfowl, are also listed.

COMMON LOON

Gavia immer (Brünnich). Seven birds were observed on an aerial flight around Payne Lake. Another was seen at Gregory Lake.

RED-THROATED LOON

Gavia Stellata (Pontoppidan). One bird was seen with a brood on the Povungnituk River.

UNGAVA CANADA GOOSE

Branta canadensis interior Todd. A typical specimen of this subspecies was collected at Payne Lake, Three others were collected at Gregory Lake, approximately ten miles from tidewater of Ungava Bay (Leaf Lake). The Gregory Lake specimens were taken from a flock of 18 flightless birds. Two of these specimens showed intergradation toward the lighter-plumaged *Branta c. canadensis* (Linnaeus); the third was typical of the Ungava Canada Goose. Manning (1949, p. 169) discusses breeding records of this subspecies along the western portions of the peninsula, and it, together with the intergradations, probably is more uniformly distributed over the area covered in this study than the Maritime or Eastern Canada Goose, *Branta c. canadensis*. We did not collect any of the latter. I am of the opinion Gregory Lake is close to the boundary line of intergradation, and Ungava Bay might be considered the boundary between the two subspecies.

The Canada Goose comprised 66 per cent of all waterfowl observed within the tundra region and 16 percent within both tundra and forest-tundra. The species was fairly well distributed throughout the peninsula except in the extreme north. Three juveniles (subspecies unknown) were banded at our station on the Leaf River. These birds were taken by driving them into a gill net.

BLACK DUCK

Anas rubripes Brewster. A flightless drake was collected on a small pond near Gregory Lake. The species was never observed at any of the interior tundra stations, but one was seen at Lake Aigneau. It represented 26 per cent of all waterfowl seen on the aerial transects in the interior forest-tundra and 58 percent of all the ducks and geese found in what might be termed tidal forest-tundra. We counted 858 of these birds along the tidal marsh on the False River where it flows into the southern end of Ungava Bay.

PINTAIL

Anas acuta Linnaeus. On July 2 a Pintail with a brood of 8 in the one-week old age class was observed at close range near Lake Aigneau in a small, shallow pond a short distance from the edge of the lake.

Manning (1946, p. 80) saw the downy young of the species on King George Island in Hudson Bay and believed that it breeds in considerable numbers in the Povungnituk region. The only other place we observed the bird was on a small pond near Payne Lake where only one was seen. Hildebrand (1950, p. 58), and Gabrielson and Wright (1951, p. 131), observed them during the breeding season on the False River and near the Koksoak River estuary at the southern end of Ungava Bay.

GOLDENEYE

Bucephala sp. What was thought to be a Barrow's Goldeneye *(Bucephala islandica)* Gmelin, was shot down in the Payne River at the outlet of Payne Lake; unfortunately we could not retrieve it. We also observed goldeneyes at Lake Aigneau, and they represented 6 percent of all waterfowl seen on the aerial transects within forest-tundra and 5 percent within the tundra region. Within

117 miles of a flight enroute to the air base in forest-tundra habitat along the Wheeler and Whale Rivers, we saw 35 goldeneyes.

OLD SQUAW
Clangula hyemalis (Linnaeus). This was the most common nesting duck in the interior tundra region and it accounted for approximately 50 percent of all the ducks seen in this type of habitat. A specimen was collected at Payne Lake. Although the numbers were not great the bird was observed in the interior on all the aerial transects except on the most northern one from Wakeham Bay. In the flight around Payne Lake 37 adults and 15 juveniles were seen. The nesting bird seems to prefer small ponds near larger lakes or rivers, and all broods which we saw were in such areas. On July 22 a duck with a brood of 5 in the one to two weeks old age class was observed on a half-acre pond 150 yards from the north side or Payne Lake.

BLACK SCOTER
Oidemia nigra (Linnaeus). A flock of 22 was observed at Lake Ptarmigan, and 3 were seen on Payne Lake.

COMMON MERGANSER
Mergus merganser Cassin. The species was observed at Payne Lake and Lake Aigneau, as well as in the False River-Whale River area.

RED-BREASTED MERGANSER
Mergus serrator Linnaeus. Although none were collected, the Red-breasted Merganser was more common than the previous species. A brood was seen on the Payne River, and over 100 were observed on the flight along the Whale and George Rivers. Both species of mergansers represented 11 percent of all waterfowl seen in the forest-tundra.

UNGAVA WILLOW PTARMIGAN
Lagopus lagopus ungavus Riley. This grouse was collected in the forest-tundra at Lake Aigneau, Leaf River, and Gregory Lake, and in the tundra habitat at Payne Lake. The year 1949 apparently was one of the high years in the cycle judging from the many birds seen. While walking about a mile along the shore of Gregory Lake I flushed 19 broods. Most of the birds were not wary.

ROCK PTARMIGAN
Lagopus mutus rupestris (Gmelin). This species was also common although much less so than the Willow Ptarmigan. The bird was collected at Payne Lake and Lake Ptarmigan and was observed at Povungnituk River and Lake Maryland.

SEMIPALMATED PLOVER
Charadrius hiaticula semipalmatus Bonaparte. Specimens were collected at Leaf River and Lake Aigneau, and it was observed at Gregory Lake. The species was not seen at any of the tundra stations.

LEAST SANDPIPER
Erolia minutilla (Vieillot). The "mud peep" was fairly common in the forest-tundra and six specimens were taken at Lake Aigneau and one at Leaf River.

SEMIPALMATED SANDPIPER
Ereunetes pusillus (Linnaeus). One specimen was collected at Payne Lake, where it was a common nester.

NORTHERN PHALAROPE
Lobipes lobatus (Linnaeus). Two birds were collected at Lake Aigneau, and the species was observed at Payne Lake and Povungnituk River.

LONG-TAILED JAEGER
Stercorarius longicaudus pallascens Löppenthin. While not particularly numerous, this bird was a familiar sight at most of the tundra stations and two records were obtained at Payne Lake and one at Lake Maryland. None were seen in the forest-tundra.

HERRING GULL
Larus argentatus Pontoppidan. An immature gull of this species was banded at Payne Lake. During the interior aerial transects in tundra and forest-tundra gulls (sp. ?) were more uniformly distributed than other birds. Most of the gulls seen from the air appeared to be *Larus argentatus* but identification was not positive. Unidentified gulls were noted, also, at all ground stations and 36 were seen on the 231-mile flight around Payne Lake.

ARCTIC TERN
Sterna paradisaea Pontoppidan. Our only record was one collected at Lake Aigneau.

NORTHERN HORNED LARK
Eremophila alpestris alpestris (Linnaeus). This was one of the most common birds observed. A total of six were collected at the tundra as well as the forest-tundra stations excepting Povungnituk River and Leaf River. Young were observed in the nest at Payne Lake.

AMERICAN ROBIN

Turdus migratorius Linnaeus. No specimens were collected, and the species was seen only at Gregory Lake, near the upper limit of the forest-tundra. Manning (1949, p. 206) in reference to a manuscript by Coates states that what appears to be a Black-backed Robin (*Turdus migratorius nigrideus* Aldrich & Nutt) was collected in this area in 1946. I can appreciate the difficulty Coates must have had taking it. A fruitless two-mile chase in the soft tundra taught me the hard way that this is an extremely wary bird in northern Ungava!

AMERICAN WATER PIPIT

Anthus spinoletta rubescens (Tunstall). One was collected at Lake Ptarmigan, at Povungnituk River, and another at Lake Maryland. This species seemed to favor rough, boulder-strewn country, which is somewhat typical of these stations. A juvenile bird, probably less than one week old, was observed at Lake Maryland on July 26.

BLACK-POLLED WARBLER

Dendroica striata (Forster). A specimen was taken at Lake Aigneau. None were observed in the interior tundra.

LABRADOR SAVANNAH SPARROW

Passerculus sandwichensis labradorius Howe. Two records were obtained at Payne Lake and another at Povungnituk River, and the bird was observed at Lake Ptarmigan. It was common each place.

EASTERN TREE SPARROW

Spizella arborea arborea (Wilson). One was collected in the forest-tundra at Leaf River, two were taken in the tundra at Povungnituk River, and another was recorded at Lake Maryland.

WHITE-CROWNED SPARROW

Zonotrichia leucophrys leucophrys (Forster). One was collected at Lake Maryland and another was taken at Leaf River. The bird was observed at Gregory Lake.

LAPLAND LONGSPUR

Calcarius lapponicus lapponicus (Linnaeus). This species was the most common of the family Fringillidae and it was observed at all the tundra stations. One specimen was collected at Payne Lake and another was obtained at Lake Ptarmigan. Young were seen in a nest at Payne Lake.

EASTERN SNOW BUNTING

Plectrophenax nivalis nivalis (Linnaeus). Although I expected to find the Snow Bunting common throughout the tundra region of the Ungava area, it was seen at only two stations. Two were taken at Lake Ptarmigan, and the bird was seen at Lake Maryland. Their favored habitat appears to be rocky, boulder-strewn hillsides, such as occur at both these stations. Some observers report it as common in the barren regions during the nesting season, but in the region which we studied, I believe it is common at this time only in the more northern portions of the peninsula.

MAMMALS

ARCTIC HARE

Lepus arcticus Ross. None was seen at any of the ground stations, and none was seen during the aerial flights — although it should have been visible from the low-flying altitude usually maintained.

COLLARED LEMMING

Dicrostonyx hudsonicus (Pallas). 1949 was apparently a high year in the lemming population cycle for this area. Lemming runways were numerous everywhere, and the species was recorded at all stations except Lake Ptarmigan where, however, the signs were abundant. Twenty-two collections were made at Payne Lake.

Since this was a high year in the cycle, I particularly wanted to carry out a population density and movement study. To accomplish this, 50 sheet-metal, collapsible, Sherman-type live traps were set out in squares at 60-foot intervals, and animals taken were toe-clipped. Unfortunately, owing to mechanical failure of some of the traps which had been poorly constructed, the study had to be abandoned.

LEMMING MOUSE

Synaptomys borealis innuitus (True). A lemming mouse, or bog-lemming, was taken at Payne Lake, and another was collected on the coast at Payne Bay Hudson Bay Post. This latter may be a northernmost record for *Synaptomys* in Ungava.

RED-BACKED MOUSE

Clethrionomys gapperi ungava (Bailey). One was collected at Payne Lake and another was taken at Lake Aigneau.

MEADOW MOUSE

Microtus pennsylvanicus labradorius Bailey. One was obtained at Lake Maryland. We also took a specimen at Wakeham Bay during a stop on a coastal aerial transect.

WEASEL

Mustela erminet Linnaeus. One weasel was seen in a stand of black spruce at the Air Base near Fort Chimo.

OTTER

Lutra canadensis (Schreber). Tommy Crawford, Hudson Bay Post Factor at Payne Bay, told me the Eskimos occasionally trapped an otter in his region, and we were fortunate enough to observe one at close range during an aerial transect along the shore of Lac Faribault, in the tundra region, at approximately Latitude 58° 55′ N., Longitude 71° 54′ W.

CARIBOU

Rangifer arcticus (Richardson). According to the Eskimos, the tundra area studied supported a heavy population of Barren Ground Caribou in the early 1900's. However, during all of our 2,476 miles of aerial transects flown at a height of 150 feet, of which 791 miles were over forest-tundra and 1,685 miles were over tundra, we did not see a single animal. We flew an additional thousand miles over this same type of country at a height of about 500 feet. I have had considerable opportunity to census White-tailed Deer in relatively heavy stands of deciduous trees after the leaves have fallen and, although some deer are undoubtedly missed they are not too difficult to see even when there is no snow on the ground. Caribou should be equally or more easily visible, and I believe that we would have seen them had they been in the tundra. The Payne Lake area is purported to have been one of the most famous caribou-hunting grounds of the northern interior, and at this station were seen many of the rock structures built by Eskimos to resemble persons. Antlers were also found. Most of the structures consisted of two or three rocks piled one on top of the other. These were evidently used by the Ungava Bay Eskimos, and those which we saw at Payne Lake were set up along ridges to divert the caribou into a converging point where they could be more easily shot. We also observed similar-type "scaribous" to the northward at the Lake Maryland station. These appeared to have been better constructed than those at Payne Lake. They were also observed as we flew along the North Branch of the Payne River, and these may have been the same as those seen by Flaherty (1918) in his westward traverse of the peninsula in 1912. He called them "deer decoys" and described the structures as "groups of large erratic boulders, each boulder topped with a smaller one and which when viewed from a distance looked not unlike a herd of grazing deer." Based on my observations as well as those of others, I believe Flaherty was in error in interpreting those structures as decoys which attracted caribou.

Stefansson (1943) says "the Copper Eskimo called these structures 'Inuksuit' meaning likeness of men. In hunting the caribou an ambush is made at an angle of two long lines of monuments, the monuments being set up from 50 to 150 yards apart according to the characteristics of the topography. The angle between the two converging lines of stone was usually 14 to 15 degrees." Birkett-Smith (1929) in describing caribou hunting by Eskimos west of Hudson Bay says "converging lines of small stone cairns several kilometers long, are built up, three or four stones being piled one on top of the other. On top of the cairns are placed grass sod with the black soil upwards. Women and children make their way behind the herd and frighten it . . . in between the rows which are so placed that the animals, on coming over a ridge suddenly find themselves between them. They then think that the cairns are men and the sod their head . . . hence their name 'Niaqucat'." Mathiassen (1933) called these converging lines caribou fences.

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BIRDS OBSERVED AT GOOSE BAY AND ELSEWHERE IN LABRADOR

V. C. WYNNE-EDWARDS

University of Aberdeen, Aberdeen, Scotland

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From July 6 to 11, 1953, when traveling on a grant from the Arctic Institute of North America, I stayed at Goose Bay. Most of the following observations were made in the immediate vicinity of the air base, but a few additional notes made elsewhere in Labrador at various dates have been added. As would be expected, there is a Canadian-zone element in the fauna of Goose Bay, at the head of Hamilton Inlet, which disappears more or less completely in the 120 miles between there and the outer coast.

NIGHTHAWK *Chordeiles minor*

One seen on July 8, pursued by redpolls, and three or more on the evening of the 10th. Austin (1932, p. 150) says "a casual visitor." Not noted by Loomis (1945) or Orr (1948).

TREE SWALLOW *Iridoprogne bicolor*

Three were seen on July 9, under conditions permitting certain identification. The tree swallow has been recorded north to Davis Inlet (Gabrielson and Wright, 1951, p. 137), and probably Chimo.

HERMIT THRUSH *Hylocichla guttata*

I found a hermit thrush singing on July 8, and heard it often subsequently in the same place; the song was unmistakable. There appear to be few records of this species in the region (Austin, 1932, p. 170; Orr, l.c.). The olive-backed (*H. ustulata*) was the common thrush at Goose Bay; the gray-cheeked *(H. minima)* was never heard and appeared to be entirely absent. As would be expected, near the outer coast in southern Labrador, for example at Cartwright (Orr, l.c.) and

St. Mary's (where I found it in July 1934), the gray-cheeked is the predominant thrush.

PALM WARBLER *Dendroica palmarum*

On July 8 I found a pair of these warblers in the open black-spruce bog below the R.C.A.F. townsite. They hung around in a persistently agitated manner, as if they had a nest nearby, and at times came within a few feet of me. There was ample time to write down a detailed description of them. The russet crown, yellowish stripe above the eye, grayish cheeks and brown upper parts, and the habit of constantly flicking the tail, identify the species. The throat and upper breast were bright yellow, faintly spotted with darker color, and the under tail coverts were again bright yellow — a description which perhaps better fits *palmarum* than *hypochrysea,* as they are commonly characterized. One of them attempted to catch an Erebia butterfly.

I have not been able to find any previous record of this bird in Newfoundland Labrador.

The only other warblers seen at Goose Bay were the blackpoll *(D. striata)* and Tennessee *(Vermivora peregrina);* both were plentiful. In 1937 I noted the blackpoll as far north as Nain, where its song was still to be heard on August 16; and I saw a male Wilson's warbler *(Wilsonia pusilla)* at St. Mary's in 1934, where it had previously been observed in 1906 by Townsend and Allen (1907, p. 410).

WHITE-THROATED SPARROW *Zonotrichia albicollis*

At Goose Bay the white-throated and white-crowned *(Z. leucophrys)* sparrows were about equally plentiful, judging by the songs heard; near the outer coast the latter is much the commoner of the two.

OTHER EMBERIZINAE

Of the other sparrows, Lincoln's *(Melospiza lincolnii)* and the slate-colored junco *(Junco hyemalis)* were also common at Goose Bay; but I could find only one pair of tree sparrows *(Spizella arborea),* and no fox sparrows *(Passerella iliaca)* nor Savannah sparrows *(Passerculus sandwichensis).* In August 1937 at Nain I saw tree sparrows feeding fledged young on the 16th and heard a fox sparrow singing still on the 17th; white-crowned sparrows were common there also. On July 9, 1934, at Niger Sound, near Battle Harbour, I found a fox sparrow's nest with three eggs, about three feet from the ground in a thicket of stunted spruce; the nest was composed of spruce twigs, lined with fine grasses and black fibers.

SLATE-COLORED JUNCO *Junco hyemalis*

The following curious fact is perhaps worth recording. On July 18, 1937, I was on one of the Torngat mountains rising on the north side of Nachvak fiord, the height of which by aneroid was 3200 feet; and during the whole time I was at the summit taking photographs and building a cairn, about twenty minutes, a junco stayed anxiously around, often only a few feet from me. Stray individuals have previously been recorded even farther north, for example in southern Baffin Island (Taverner, 1934, p. 128), but for a bird whose normal range extends only to the limit of trees this bleak frost-shattered mountain top, almost entirely devoid of vegetation, seems a strange dwelling place.

ADDITIONAL SPECIES OBSERVED

In addition to the birds already mentioned the robin *(Turdus migratorius),* ruby-crowned kinglet *(Regulus calendula),* common redpoll *(Carduelis flammea)* and white-winged crossbill *(Loxia leucoptera)* were common at Goose Bay. I saw no chickadees there, though *Parus hudsonicus* was found at Nain and Battle Harbour in August 1937.

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DRUMMOND'S VOLE IN MANITOBA

STUART CRIDDLE

Aweme, Treesbank, Manitoba

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My first introduction to Drummond's vole *Microtus pennsylvanicus drummondii* (Audubon and Bachman) was made under strikingly different physiographical conditions to those which prevail in the district today.



At that time, 1882, all the lower areas had water in them. Some were merely small ponds, or pools, only a few inches deep, while others in proportion were almost small lakes covering many acres and up to three feet or more in depth. All these ponds have long since dried up and the water-loving animals and plants which then inhabited them have vanished from the district. Many species of ducks, grebes, coots, rails and shore birds, terns, bobolinks and blackbirds nested in or close about the ponds and a few sandhill cranes and Canada geese nested within a few miles of us. Muskrat houses dotted all the large ponds and odd beaver lodges were present in a few. Mosquitoes swarmed in tens of millions and during the spring and early summer evenings the voices of countless numbers of bullfrogs, toads and salamanders pouring forth their nuptial songs of love from every pond made music which was perhaps a trifle harsh yet decidedly pleasing in its cheerful simplicity.

Today the ponds in which we learned to swim are gone and instead of water the low places now hold dense stands of balsam poplar and trembling aspen. Some of the trees are twenty inches or more through and over sixty feet tall. Mice were also plentiful in those early days, from the luxuriant growth at water edge to the sparsely covered prairie uplands. It may have been one of these small voles which first awoke my interest in mammalogy. Voles are a fighting species and when cornered will tackle anything regarless of size. I love pluck and this may have drawn my attention to these most interesting and pugnacious little creatures.

DISTRIBUTION IN MANITOBA

With the exception of two small areas, one across the northern boundary of the province and the other close along the Ontario-Manitoba border, Drummond's vole is found in all suitable parts of the province.

BRIEF DESCRIPTION

Drummond's vole (Fig. 1) is a strong pugnacious little animal, well fitted for life under widely different climatic and food conditions. Its winter fur is dense, long and soft but in summer it grows much shorter and is somewhat rough. The ears are rounded, medium size and in winter are well protected by the long fur about them. Eyes are deep set, black and small. Legs are strong, well formed and rather short. The tail is short and tapers from base to tip.

COLOR

Drummond's vole, like many Manitoba mammals, birds and insects, varies very greatly in color and size, so that only a general color description can be given. The upper parts are dark gray over-washed with a rusty or deep brown which tends to lighten down the sides. The belly is a clouded white, the dark underfur showing strongly through the white. I have specimens which are a rich rusty brown, others a dark gray lightly washed with different shades of brown and still others quite light gray with a yellowish, or even pinkish, tinge to the longer fur or guard hairs. Usually the specimens taken from the drier uplands are grayer in color and perhaps a trifle smaller than those from the swampy lowlands. But this does not always hold true, as I have taken very light specimens from swamps and quite dark individuals from the prairies. However, specimens from the Manitoba prairies are decidedly lighter with more rusty brown about them than are those from the northern regions such as Gillam and Churchill. The latter perhaps average slightly larger than their southern relations.

MEASUREMENTS

In an effort to obtain a nearly accurate scale of measurements for the Aweme district I secured and measured a large number of fully mature voles and from them selected the measurements of twenty males and twenty females for the table below (Table 1). I have different specimens in my collection from distant parts of the province to enable a table of worthwhile averages being made, so have selected fully mature specimens to represent the districts from which they came. By doing this I feel that a much better record of size is obtained than if I had used a series of specimens regardless of age or sex.

It is interesting to compare my records with those given by Vernon Bailey in his masterly work, *A Biological Survey of North Dakota,* (No. 49 in the series "North American Fauna," 1926). For the subspecies *drummondii* Bailey records the following averages: total length, 145.0 mm; length of tail vertebrae, 39.0 mm; length of hind foot, 17.8 mm. For *M. p. pennsylvanicus* the average lengths are: total, 171.0 mm; tail vertebrae, 46.0 mm; hind foot, 21.2 mm.

Table 1. — MEASUREMENTS OF MATURE VOLES FROM MANITOBA

District	No. of specimens	Sex	Length (mm)			Weight (grams)
			Total	Tail vertebrae	Hind foot	
Aweme	20	♂	197.0 - 151.0	46.0 - 40.5	21.0 - 17.5	45.5 - 30.2
			Av. 162.8	Av. 43.0	Av. 17.8	Av. 37.2
Aweme	20	♀	178.0 - 144.0	51.5 - 41.0	21.5 - 17.5	49.9 - 30.2
			Av. 159.0	Av. 45.5	Av. 18.3	Av. 35.9
Souris	1	♀	186.0	49.5	17.7	53.6
Tiger Hills	1	♂	173.0	47.5	18.5	41.2
South Junction	1	♂	161.0	50.4	20.5	32.5
Sandy Lands	1	♂	174.1	49.3	21.5	Not recorded
Hilbre	1	♂	172.9	46.9	17.8	42.5
Gillam	1	♂	163.5	34.0	20.0	Not recorded
Churchill	1	♂	170.0	44.0	21.0	Not recorded
Churchill	1	♂	164.0	39.0	20.0	Not recorded

BREEDING AND YOUNG

When voles live well away from man and his farming activities, unseasonable weather may cause them to advance or retard the breeding season by two or three weeks in the spring time and by nearly as much in the fall of the year. However, during normal seasons sexual activities commence in either late March or early April and continue without intermission until towards the end of September. While I have found young of different ages all through the winter, these have been from grain stacks, straw piles or areas adjacent to farm buildings. I have no record of young being found on the open prairies or lowlands during the winter, so that it is quite evident that when living under natural conditions Drummond's vole does not breed during the colder months.

Females which have wintered over, and are therefore fully adult animals, have from three to four litters a season, occasionally five, with an average of approximately six young to a litter. The young females of the first litter breed twice before the close of the season and those of the second litter once. These juvenile females average four young to a litter, so that the adult mother and her daughters may produce a family of between fifty and sixty young in a normal breeding season of six months.

At birth the young are a dark pink. They are blind, toothless and naked, and have very short legs and tail. They are able to squirm about and utter low squeaky sounds. They are large feeders and grow rapidly. As soon as they are covered with short fur they leave the nest to scatter well away from each other. The urge to abandon the natal nest as soon as possible is inherited by many small animals and there is no questioning the fact that by doing so they have a much better chance of survival than they would have if huddled together in the nest a day longer than necessary.

NESTS

Usually there is very little difference in the relative size and comfort of the nests made for summer or winter use, although the places in which they are made does vary greatly. Summer nests are usually found beneath protective coverings of one sort or another, or else underground in an abandoned pocket gopher, ground squirrel or badger hole, while the winter nest is more often than not made on the surface beneath the snow. Dead grass of the previous season's growth which has become slightly softened by exposure is preferred and while that used for lining may be either finely shredded or cut up, it is often left as gathered from the plant. Softer materials such as cotton from prairie anemone, thistle down, feathers or animal fur are seldom used in lining the nest. Occasionally when there are ample supplies of food and nesting materials close at hand the nest will be quite large and well made, but when such materials are scarce it is a flimsy structure made from any dry material within reach. Such nests are usually temporary affairs used only until the food close about them has become exhausted. The voles will then move on to a new position a few yards ahead and make a new nest. This nomadic life beneath the snow may continue all winter and by spring a long chain of nests will be exposed as the snow retreats, showing the large amount of work a few voles have done during the cold months of winter.

The nest has several useful functions. First of all it is used as a natal chamber. In the summer it keeps the voles dry and comfortable and in winter it prevents contact with the snow. When two or three voles are closely snuggled together in sleep their body heat and long soft fur keep them comfortably warm through the coldest nights of winter without the aid of a well-made nest.

RELATIVE ABUNDANCE

The first object of this part of the study was to determine, if possible, the extent of the violent fluctuations which are known to take place among our small mammals every few years and to find out if these fluctuations occurred in periodic sequence or not. To secure information on these questions I decided first to keep daily records of all the mammals killed on the farm and adjacent lands, secondly to examine those species thought to be beneficial without injuring them and thirdly to maintain a close watch on those living in the wilds. My original objectives were soon extended to include relative age, sex and the number of young carried by pregnant females. When started, this seemed to be a simple plan for gaining the information wanted, but it was soon realized that there were many unavoidable conditions constantly cropping up which could not be controlled and which affected the seasonal activities and catch to a large

degree. What was hoped to be a simple undertaking turned to be a most complex study. Factors such as sudden climatic changes, loss from diseases and predaceous animals and occasional winter rains and heavy thaws which iced over their food, all affected the populations of the different species by an undetermined amount during the twenty-three years of the study.

Included in the 22,997 mammals recorded during the study are 6575 Drummond's voles. These, like all the specimens, are catalogued in the following order: adult male, juvenile male, adult female, and juvenile female. The object in making these age distinctions was to try and determine the percentage of adults to young and to determine the ratio of one sex to the other. Besides giving this information, Table 2 gives the totals for each year and shows the great disparity in these totals. While no smooth rhythm can be found in the figures given, there are slight signs of a ten-year cycle having taken place. There are, however, far stronger indications that when conditions are favorable the voles increase very rapidly and when reverse conditions prevail they decline just as fast. Table 3 records the greatest monthly catch for each year of the study. From Table 4 it will be seen that Drummond's vole has from one to nine young at birth. The largest number of pregnant females were captured in August and the most frequent size of litter was from four to six.

FOOD

In an effort to find out which one of the many plants eaten by Drummond's vole was preferred I soon realized that such a plant must have a wide distribution and be able to thrive in a majority of the localities which were inhabited by the vole. After examining a large number of winter and summer feeding grounds I found that the highly adaptable and widely distributed blue grass *Poa pratensis* met these requirements

Table 2. — DRUMMOND'S VOLE TAKEN IN MANITOBA, 1928 - 1950.

Year	Adult ♂	Juvenile ♂	Adult ♀	Juvenile ♀	Total	Rainfall (in.) April to October	Remarks
1928	151	511	169	315	1146	16.28	Abundant
1929	66	75	59	82	282	8.39	Common
1930	29	23	30	21	103	12.50	Scarce
1931	29	17	33	17	96	13.13	Scarce
1932	65	26	47	34	172	10.60	Scarce
1933	39	21	43	29	132	14.38	Scarce
1934	20	11	24	13	68	7.80	Rare
1935	114	86	135	118	453	18.02	Very common
1936	131	87	144	138	500	10.40	Very common
1937	128	120	208	161	617	17.61	Abundant
1938	29	27	36	27	119	8.55	Scarce
1939	69	68	81	72	290	14.10	Common
1940	42	37	44	52	175	16.12	Rather scarce
1941	94	158	102	146	500	16.64	Very common
1942	27	54	26	54	161	12.23	Rather scarce
1943	48	44	40	52	184	16.72	Fairly common
1944	84	134	170	128	516	17.63	Abundant
1945	51	35	62	39	187	13.28	Fairly common
1946	47	56	61	69	233	11.35	Common
1947	59	60	69	73	261	11.97	Common
1948	42	42	58	42	184	14.10	Fairly common
1949	42	18	30	32	122	9.50	Scarce
1950	22	14	20	18	74	19.86	Rare
	1428	1724	1691	1732	6575		
	3152		3423				
	6575						

Table 3. — GREATEST MONTHLY CATCH OF DRUMMOND'S VOLES TAKEN IN MANITOBA, 1928-1950

Year	Month	Adult ♂	Juvenile ♀	Adult ♀	Juvenile ♂	Total
1928	Sept.	66	155	58	152	431
1929	Aug.	4	37	9	32	82
1930	Sept.	12	16	14	13	55
1931	Sept.	10	10	5	8	33
1932	Sept.	22	15	23	20	80
1933	Aug.	10	15	12	24	61
1934	Aug.	7	3	5	6	21
1935	Oct.	38	44	75	61	218
1936	Aug.	21	27	22	44	114
1937	Sept.	52	61	63	87	263
1938	Sept.	13	18	11	18	60
1939	Sept.	53	64	64	67	248
1940	Sept.	8	18	12	25	63
1941	Oct.	59	97	57	89	302
1942	Oct.	7	20	8	18	53
1943	Sept.	27	32	24	37	120
1944	Sept.	44	97	71	84	296
1945	Aug.	17	16	19	15	67
1946	Sept.	25	38	30	41	134
1947	Sept.	22	33	26	40	121
1948	Sept.	4	12	7	12	35
1949	Aug.	9	6	5	10	30
1950	Aug.	6	7	8	8	29
		536	841	628	911	2916
Total		1377		1539		
			2916			

Table 4. — FREQUENCY OF PREGNANT FEMALES ACCORDING TO THE MONTH OF CAPTURE AND THE NUMBER OF EMBRYOS IN THE UTERUS.

Month of capture	Females carrying embryos									Total females	Total embryos
	1	2	3	4	5	6	7	8	9		
March	0	0	0	1	0	0	0	0	0	1	4
April	0	0	0	3	8	2	2	1	0	16	86
May	0	0	0	1	3	7	6	0	0	17	103
June	0	0	0	2	2	4	3	2	0	13	79
July	0	0	1	4	3	5	0	2	1	16	89
August	0	2	12	24	27	27	6	3	0	101	499
September	1	2	9	14	18	18	1	1	0	64	301
October	0	1	2	5	5	2	0	0	0	15	65
November	0	1	0	0	0	0	0	0	0	1	2
December	0	0	1	0	0	1	0	0	0	2	9
Total	1	6	25	54	66	66	18	9	1	246	1237

much better than any other native plant. It commences to grow first thing in the spring, makes strong growth in the fall and remains partly green all winter. Moreover it provides good coverage and nesting material. Besides blue grass there are many other species of grasses, sedges and herbaceous plants which provide green food during the growing season and a few persist through the winter.

Besides green food there are many other things eaten, for Drummond's vole is a truly omnivorous feeder. Among the more important of these are seeds which are eaten whenever procurable. Many species of insects are especially important during prolonged periods of hot dry weather when they provide moisture which cannot be secured from other sources at such times. Wild fruits are eaten in season. Fleshy root-stalks and near-surface tubers provide much winter food, and on the prairie the three flowered avens *Geum triflorum* is important. I have known large patches of this interesting plant to be eaten over so closely that it was all but killed. Flesh and toadstools are eaten but they are of little value. Deer antlers and bits of bone are gnawed, probably for the mineral salts they contain.

Usually bark is only eaten during the winter and then in small amounts, but when the plants which normally produce an abundance of food fail to mature or become iced over by freezing rain or melting snow the voles are forced to feed on bark. At such times they may damage valuable shrubs and young trees. However unless one has had wide acquaintance with their normal winter habits it is almost impossible to determine whether the mischief has been done by this vole, *Microtus,* or the red-backed vole, *Clethrionomys,* which always depends largely on bark for its winter food and in most cases is responsible for such damage. While Drummond's vole will eat bark from small trees it prefers young shoots or twigs which can either be cut off close to the ground or from older wood. The twig is slowly drawn forward as the bark is eaten. Once a stripped portion gets in the way it is cut off and soon a neat little pile of stripped wood is built up. These piles can often be found among prairie rose and sand cherry bushes in the spring. Tall seeding grass and ripening grain stems are cut down in a similar manner; the vole moves with it to some protective cover under which the stalk is cut into short lengths until the head is reached and the seeds eaten from it. As far as I know this peculiar practice of cutting the useless wood or straw into short lengths is only done by *Microtus* or I have failed to find signs of other species having done so.

Of the many introduced grasses, awnless brome *Bromus inermis* and crested wheat grass *Agropyron cristatum* are preferred and the former has become an important food plant over the vast area it has spread. Alfalfa is greatly favored by the vole. When abundant they may severely damage growing crops of this rich legume and may feed exclusively in the stack during the winter. Grain of all kinds is eaten in preference to most other forms of food and I have seen severe damage done to swathed and stooked grain which had been left in the field over winter.

SWIMMING

In the early days while hunting about the nearby ponds we occasionally noticed one of these voles take to the water, and as they swam so well they were called water voles. Probably because there was so much rank growth about the ponds and the water was shallow we never noticed them dive below the surface. However one day while walking along the Assiniboine river I saw a small animal dive from the bank and go down a foot or more, then swim like a silver streak for six or eight feet before coming to the surface. I mistook it for a rare water shrew and in my eagerness to secure it for my collection nearly fell head first into the river. On capturing it I got well bitten and discoverd that I had only captured a Drummond's vole. Since then I have seen several others plunge into the water and it is quite evident that they are as much at home in the water as they are on dry land.

FIGHTING

Drummond's vole is a pugnacious little animal that will fight to the last gap in an effort to save its life when cornered. I have often seen one catch a dog by the nose or lip and hang on like grim death and one can seldom handle an adult without getting severely bitten. Among themselves they fight like little demons using both tooth and claw and most old males show

scars received in battles they have fought. While hawks, owls and crows catch them with ease, gulls are often driven off by adults as the following incident will show. One morning while working on the land I saw an old male thrown out by the plow. He at once dashed for cover but was spotted by a following gull who settled and ran for the vole, the vole in turn charged at the gull which retreated in haste. Other gulls quickly came down and soon formed a tight circle about the vole who stood with scissoring teeth and threatening demeanor, daring any one of them to approach, and when one attempted to do so he would rush at it like a little ball of fury and drive it back. This went on until the gulls gave up and departed. Then the vole quickly burrowed under a nearby clod to safety.

ECONOMIC STATUS

Like many species of small rodents Drummond's vole prefers seeds, especially cultivated grain to all other kinds of food. While many of the seeds have little value or are gathered from noxious weeds such seeds provide only a small amount of the food consumed when cultivated grain can be had. A few years ago I looked over a large field of wheat that was surrounded by brush and heavy grass. The field had been swathed rather late and heavy rains had prevented further work on the field that fall, Snow covered the crop in early winter and spring moisture prevented the farmer from working on the field until mid-June. By then the crop was so badly damaged by *drummondii* and deer that it was not worth harvesting. The voles had made hundreds of nests, had cut a great deal of the straw into short lengths, eaten a few grains from a head and discarded the rest. The waste of grain was terrific, many, many times the amount that was eaten. I have occasionally found damage done to alfalfa and other growing crops and, under certain adverse winter conditions small orchard trees and flowering shrubs and plants may be severely damaged, or killed back beneath the snow.

In the northern parts of their range beyond the bounds of agriculture, Drummond's vole takes its place with many other small rodents in feeding valuable fur bearing animals, also hawks and owls, which would hunt more important game if there were no small rodents to be caught. Therefore we have to place Drummond's vole in both beneficial and harmful categories. However, due to its destructiveness to agricultural products it must be classed among the many minor pests of southern Manitoba.

CONTROL

When in sufficient numbers the many species of predators, weasels, owls, hawks and crows with the help of a few others, will take care of the natural increase of most of our small rodents. However there are times when conditions are so favorable for reproduction that all the predators have little effect on their enormous numbers. When this occurs considerable damage will be done unless preventive measures are taken. Perhaps the best method for control is to destroy the breeding places adjacent to gardens, young orchards or anything that should have special protection, by keeping grass and weeds cut and by removing all trash from the area. When this cannot be done, a few post holes between two and three feet deep scattered about will help. Such holes with a few shallow pans of poisoned grain well protected from birds and weather will take care of most small rodents until winter sets in. They will not, however, give sufficient protection after the ground becomes covered by snow as some voles travel long distances beneath it and may end up in a herbaceous garden or orchard of young trees. Trampling the snow well down around the small trees will prevent much damage, but special trees and shrubs should have wire cloth or heavy paper wrapped closely about them to a height of a foot or more depending on the depth of the snow.

CHRISTMAS BIRD CENSUS FOR 1955

West Middle Sable, N.S. (West Middle Sable, Louis Head and beach, Little Harbour, Hemeon Head, Matthews Lake; all within 7.5 mi. of school in W. Mid. Sable; mixed woods, largely coniferous, 53%; ocean shore, 9%; sheltered brakish water, 16%; sand beach, 9%; scattered rural community, 13%.) — Dec. 28, 1955, 7.45 a.m. to 4.45 p.m.; 95% cloudy, temp. 21° to 26°; wind N to NE, 5-10 m.p.h.; ground covered with 9 in. snow, less near ocean; ponds frozen, extensive ice on sheltered brackish water. 2 observers, 1 at feeding-station and 1 in field party. Hours afield 9 on foot; party miles, 16 on foot.

Horned Grebe, 1; European Cormorant, 78; Canada Goose, 2400; Black Duck, 279; American Golden-eye, 35; Buffle-head, 6; Old-squaw, 1; Common Eider, 26; White-winged Scoter, 1; Surf Scoter, 1; American Merganser, 3; Ruffed Grouse, 1; Great Black-backed Gull, 13; Herring Gull, 230; Hairy Woodpecker, 2; Horned Lark, 10; Canada Jay, 1; Blue Jay, 3; Raven, 1; Crow, 19; Black-capped Chickadee, 6; European Starling, 7; Bronzed Grackle, 1; Cowbird, 3; Slate-colored Junco, 26; White-throated Sparrow, 1; Song Sparrow, 1; Snow Bunting, 63. Total, 28 species; 3219 individuals. Also seen in area in count period: Sharp-shinned Hawk, Great Horned Owl, Brown-capped Chickadee, Robin, Northern Shrike, Myrtle Warbler, Evening Grosbeak, Tree Sparrow, Fox Sparrow.

—Harrison F. Lewis and Laura N. Lewis.

Hudson Heights, Hudson and Como, Que. (Same area as in 1953). — Jan. 2, 1956, 7.30 a.m. to 4.30 p.m.; sunny; temp. —10° to 10°; wind N, 6 m.p.h. increasing to 15 in p.m.; 10 in. snow; all water frozen. 23 observers in 9 parties. Total party hours, 43 (16 on foot, 3 by car, 14 on skis); total party miles, 82 (26 on foot, 27 by car, 29 on skis).

Ruffed Grouse, 3; Great Horned Owl, 1; Hairy Woodpecker, 14; Downy Woodpecker, 7; Canada Jay, 1; Blue Jay, 80; Black-capped Chickadee, 137; White-breasted Nuthatch, 19; Red-breasted Nuthatch, 4; Brown Creeper, 1; American Robin, 2; Northern Shrike, 1; Common Starling, 59; House Sparrow, 66; Evening Grosbeak, 150 (32 + 118 est.); Pine Grosbeak, 31; Common Redpoll, 342; Slate-colored Junco, 6; Tree Sparrow, 5; Snow Bunting, 35. Total, 20 species; 977 individuals. Seen in area: Dec. 30, American Goldfinch, 1; Jan. 1, Snowy Owl, 1; Jan. 3, Pileated Woodpecker, Red-shouldered Hawk.

—Vi. Bryan, Mr. and Mrs. E.D. Croll, Mr. and Mrs. R.H. Cundill, H. Cundill, R. Cundill, Mr. and Mrs. G.A. Golden, A. Grubert, C. Hope, B. Knox, A.R. Lepingwell, Mrs. D.L. Macaulay, D. Macauly, R. MacDuff, H. Harpole, Vi. Mullan, Mrs. G. Riley, May Riley, Mr. and Mrs. H.V.L. Peterson, Mrs. R.W. Wright (compiler).

Montreal, Que. (Mount Royal, St. Helen's Island, Nun's Island, Grove Hill, north and south shores of St. Lawrence River from Mercier Bridge to Victoria Bridge). — Dec. 26, 1955, 8:30 a.m. to 4:00 p.m.; mostly overcast; temp. 9° to 16°; wind SW, av. 14 m.p.h.; 8-9 inches of snow; heavy shore and brash ice on river. 24 observers in 6 parties. Total party hours, 32. Total party miles, 81 (25 on foot, 54 by car, 2 by boat).

Mallard, 2; Black Duck, 175 (part. est.); Am. Golden-eye, 297 (part. est.); White-winged Scoter, 6; Am. Merganser, 62; Sparrow Hawk, 2; Ring-necked Pheasant, 20; Glaucous Gull, 1; Great Black-backed Gull, 3; Herring Gull, 18; Great Horned Owl, 1; Hairy Woodpecker, 11; Downy Woodpecker, 10; Horned Lark, 7; Crow, 2; Black-capped Chickadee, 48; White-breasted Nuthatch, 5; Brown Creeper, 8; Am. Robin, 14; Cedar Waxwing, 35; Gray Shrike, 3; Starling, 84; House Sparrow, 198 (part. est.); Pine Grosbeak, 2; Common Redpoll, 10; Pine Siskin, 2; Snow Bunting, 75 (est.). Total: 27 species; about 1,101 individuals. Seen in area within week: Screech Owl, 2.

—A. Bain, Miss S. Boyer, J.D. Cleghorn, Mrs. H.E. Chalk, T.B. Cooper, J. Cooper, A.D. Dawson, P.H. Du Boulay, J. Evans, Miss G. Hibbard, B. Holmes, A.W. Kelly, J. Lowther, I. McLaren, Mr. and Mrs. G.H. Montgomery, J. Montgomery, Mrs. P. Roberts, J.W. Robinson, J. Rolland, D. Ryan, Dr. D.E. Sergeant, M. Seymour, Miss W. Wilson (Province of Quebec Society for the Protection of Birds).

Quebec, Que. (Same area as in 1954, Ste. Foy to Quebec Bridge, Quebec seaport to Island of Orleans bridge, Plains of Abraham and Quebec Zoological Garden; town suburbs 25%, fields 17%, coniferous forests 5%, deciduous woods 8%, mixed woodlands 35%, shores 10%). — Dec. 26, 1955, 7:15 a.m. to 4:30 p.m.; cloudy, temp. 3° to 15°; wind NW, 6-8 m.p.h.; 14-18 inches of snow on ground; small rivers frozen, large moving icefields on St. Lawrence river. 23 observers in 5 parties. Total party hours, 29 (26 on

foot, 3 by car). Total party miles, 67 (27 on foot, 40 by car).

Ruffed Grouse, 4; Herring Gull, 25; Iceland Gull, 9; Great Black-backed Gull, 2; Hairy Woodpecker, 4; Downy Woodpecker, 4; Blue Jay, 7; Black-capped Chickadee, 19; White-breasted Nuthatch, 1; Red-breasted Nuthatch, 1; Brown Creeper, 1; Robin, 12; Cedar Waxwing, 32; Starling, 129; House Sparrow, 528; Bronzed Grackle, 1; Evening Grosbeak, 24; Pine Grosbeak, 90; Common Redpoll, 121; Slate-colored Junco, 1; Tree Sparrow, 6. Swamp Sparrow, 1. Total: 22 species, 1,022 individuals. Seen in area: Dec. 25, Gray Shrike, 1; Dec. 27, Am. Crow, 2 and White-winged Crossbill, 1; Dec. 28, Glaucous Gull, 1; Dec. 29, Arctic Three-toed Woodpecker, 1.)

—B. Asselin, Miss G. Boucher, Miss P. Bouffard, Miss M. Bourret, Miss G. Cadrin, Miss G. Carrier, R. Cayouette (compiler), R. Dumais, Mr. and Mrs. J.-M. Gauvreau, P. Germain, P. Hamel, P. Leclerc, L. Lemieux, R. Lepage, G. Lepage, L.-A. Lord, Miss P. Picard, Miss L. Samson, R. St-Laurent, Miss R. Vallée, Miss T. Vézina, P. Vézina (Club des Ornithologues).

St. Félicien, Lake St. John region, Que. — Dec. 26, 1955; clear, sunny; temp. 18°. One observer. 6½ miles on foot (2 miles in town).

Black-capped Chickadee, 3; Starling, 11; House Sparrow, 203; Pine Grosbeak, 2; Redpoll, 27. Total, 5 species, 246 individuals.

—Edmund A. Welch.

Brockville, Ont. (Brockville to five miles west along the St. Lawrence River). — December 18, 1955, 8 a.m. to 4.30 p.m. Weather from 8 a.m. to 1 p.m. continuous light snow; from 1 p.m. to 4.30 p.m. cloudy, intermittent snow, some sunny periods. Temp. 25° to 32°; wind light; depth of snow on level 4" to 5"; creeks and marshes frozen; river open.

Black Duck, 2; Greater Scaup, 377 +; Common Golden-eye, 68; Herring Gull, 54; Pileated Woodpecker, 3; Hairy Woodpecker, 2; Downy Woodpecker, 3; Blue Jay, 1; Black-capped Chickadee, 11; White-breasted Nuthatch, 4; Brown Creeper, 2; Starling, 231; House Sparrow, 152. Total, 13 species; about 910 individuals.

—David Hurrie.

Carleton Place, Ont. (A circle of 7½-mile radius centered on Bridge St. at the Mississippi River). — December 31, 1955, 10 a.m. to 4.30 p.m.; overcast, occasional sun; wind W, light; temp. 4° to 10°; six inches of snow. 23 observers in 6 parties. Total party hours, 34; total party miles, 218½ (18½ on foot, 210 by car).

American Goldeneye, 40; Hooded Merganser, 1; American Merganser, 7; Ruffed Grouse, 8; Ring-necked Pheasant, 3; Rock Dove, 161; Hairy Woodpecker, 6; Downy Woodpecker, 7; Blue Jay, 30; Common Raven, 1; American Crow, 6; Black-capped Chickadee, 52; White-breasted Nuthatch, 9; Brown Creeper, 1; Northern Shrike, 6; Starling, 158; House Sparrow, 359; Evening Grosbeak, 108; Purple Finch, 2; Pine Grosbeak, 16; Redpoll, 199; Pine Siskin, 2; American Goldfinch, 1; Tree Sparrow, 2; Snow Bunting, 739. Total species, 25; total individuals, 1,924.

—John Bird, A.E. Bourguignon, Howard M. Brown, Miss S. Clark, Charlotte Dill, Leonard Elliott, D.A. Findlay, D.D. Findlay, D.G. Findlay, D.H. Findlay, D.K. Findlay, Mrs. D.K. Findlay, George E. Findlay (compiler), Janet Findlay, Sheila Findlay, W.F. Findlay, W.R. Findlay, Bettey Halpenny, E.S. McIlwain and McIlwain, Jr., Eric L. Mills, E.H. Ritchie, Michael Spencer.

Hamilton, Ont. (Same area as in former years). — Dec. 26;, 7:30 a.m. to 7:30 p.m.; cloudy with sunny intervals; temp. 27° to 17°; wind varying from W to NE to WNW, 3 to 8 m.p.h.; ground bare in open, with snow in woods; marshes frozen, harbor partly open. 42 observers in 22 parties. Total party hours, 125 (111 on foot, 14 by car), total party miles, 363 (140 on foot, 223 by car).

Common Loon, 1; Horned Grebe, 2; Great Blue Heron, 1; Blue Goose, 1; Mallard, 113; Black Duck, 128; Canvas-back, 17; Greater Scaup, 303; Lesser Scaup, 10; Am. Golden-eye, 145; Buffle-head, 16; Old-squaw, 5; White-winged Scoter, 4; Ruddy Duck, 1; Am. Merganser, 512; Red-breasted Merganser, 1; Cooper's Hawk, 2; Red-tailed Hawk, 27; Rough-legged Hawk, 3; Sparrow Hawk, 14; Ruffed Grouse, 3; European Partridge, 4; Ring-necked Pheasant, 36; Glaucous Gull, 3; Great Black-backed Gull, 198; Herring Gull, 6,400; Ring-billed Gull, 7; Screech Owl, 7; Great Horned Owl, 6; Snowy Owl, 1; Long-eared Owl, 5; Belted Kingfisher, 1; Yellow-shafted Flicker, 1; Red-headed Woodpecker, 2; Hairy Woodpecker, 14; Downy Woodpecker, 55; Horned Lark, 4; Blue Jay, 97; Am. Crow, 74; Black-capped Chickadee, 274; White-breasted Nuthatch, 18; Red-breasted Nuthach, 10; Brown Creeper, 25; Winter Wren, 2; Carolina Wren, 2; Mockingbird, 1;

Am. Robin, 3; Hermit Thrush, 1; Golden-crowned Kinglet, 12; Cedar Waxwing, 34; Northern Shrike, 5; Common Starling, 2,900; House Sparrow, 1,400; Eastern Meadowlark, 2; Purple Grackle, 7; Cardinal, 86; Evening Grosbeak, 2; Purple Finch, 6; Pine Grosbeak, 11; Common Redpoll, 34; Pine Siskin, 780; Am. Goldfinch, 51; Red Crossbill, 35; White-winged Crossbill, 11; Eastern Towhee, 1; Slate-colored Junco, 731; Am. Tree Sparrow, 586; Field Sparrow, 2; White-throated Sparrow, 4; Swamp Sparrow, 4; Song Sparrow, 34; Snow Bunting, 2. Total, 72 species; about 15,300 individuals. Also seen in count period: Bald Eagle, Tufted Titmouse and White-crowned Sparrow.

—Frank Bell, R.D.F. Bourne, Dennis Brooks, Miss Stella Brown, Don Bucknell, W.I. Campbell, Kenneth J. Cox, Robert Curry, James A. N. Dowall, W.A.T. Gilmour, Leslie A. Gray, Ian Halladay, Peter Hamel, John Hencher, David Hick, George Holland, Angus B. Jackson, Miss Margaret Lamb, Thomson Lawrie, Robert MacLaren, Miss Eleanor Malcolm, Julius Mannheimer, C. Douglas McCallum, George O. McMillan, George Meyers, Glen Meyers, Mr. and Mrs. John J. Miller, Mrs. Carl Morden, John W. Moule, Albert B. Nind, George W. North (compiler), Laurel E. North, Mr. and Mrs. C.L. Powell, David K. Powell, Robert K. Sargeant, Douglas Smith, Robert Stamp, Miss Laura Stewart, Miss Mabel Watson, J. Harvey Williams (Hamilton Nature Club).

Huntsville, Ont. — December 18, 1955, 8 a.m. to 5 p.m.; temp. 20° at 8 a.m., falling to 10° in the afternoon; cloudy in morning, clear in afternoon; calm; all small bodies of still water frozen, rivers and larger lakes partly open; 15 inches of snow. 18 observers in 8 parties.

Common Golden-eye, 7; Ruffed Grouse, 3; Herring Gull, 1; Betled Kingfisher, 1; Pileated Woodpecker, 1; Hairy Woodpecker, 19; Downy Woodpecker, 12; Canada Jay, 1; Blue Jay, 65; Black-capped Chickadee, 100; White-breasted Nuthatch, 16; Red-breasted Nuthatch, 12; Northern Shrike, 1; Starling, 103; English Sparrow, 126; Evening Grosbeak, 92; Pine Grosbeak, 12; Redpoll, 111; Siskin, 36; White-winged Crossbill, 27;- Snow Bunting, 80. Total, 21 species; 826 individuals.

—M. and Mrs. Jack Bird, A. Conway, P. Conway, Mr. and Mrs. E. Farnsworth, D. Fletcher, J. Kay, Mrs. Langridge, A.C. May, N. May, Mrs. Mills, B. McAlpine, Mr. and Mrs. E.G.R. Rogers, R. Rutter, Mr. and Mrs. W. Waters (The Huntsville Nature Club).

Kingston, Ont. (A 7½-mile radius centering on Macdonald Park, and including Cataraqui River and Creek, shores of Lake Ontario and St. Lawrence River. Wolfe Island was not covered this year since the lake was frozen unusually early and the ice was still unsafe. Farmland 23%, urban centers 6%, marshes 15%, water 23%, mixed woodlots 33%). — Dec. 31, 1955, 7:30 a.m. to 5:15 p.m.; variable cloud, increasing throughout day; temp. 7° to 14°, wind NNE, 5-15 m.p.h.; ground covered with 2 to 4 inches hard snow and ½ inch fresh powder snow; all waters and marshes frozen except Cataraqui River just below Kingston Mills. 18 observers in 7 parties. Total party hours, 57 (25 by car, 32 on foot); total party miles, 344 (285 by car, 59 on foot).

Black Duck, 21; American Golden-eye, 15; Hooded Merganser, 1; American Merganser, 35; Goshawk, 1; Cooper's Hawk, 1; Red-tailed Hawk, 1; Bald Eagle, 1; Marsh Hawk, 2; Sparrow Hawk, 3; Ruffed Grouse, 18; Herring Gull, 2; Great Horned Owl, 1; Belted Kingfisher, 1; Pileated Woodpecker, 1; Hairy Woodpecker, 10; Downy Woodpecker, 20; Blue Jay, 32; Black-capped Chickadee, 260; White-breasted Nuthatch, 18; Red-breasted Nuthatch, 7; Brown Creeper, 3; Robin, 1; Northern Shrike, 2 Starling, 156; House Sparrow, 111; Rusty Blackbird, 2; Evening Grosbeak, 62; Pine Grosbeak, 12; Redpoll, 370; American Goldfinch, 108; White-winged Crossbill, 237; Tree Sparrow, 325. Total, 33 species; about 1,840 individuals. Seen in area: Dec. 24, Great Black-backed Gull; Dec. 26, Cedar Waxwing; Dec. 29, Hungarian Partridge; Jan. 1, Swamp Sparrow, Eastern Meadowlark; Jan. 2, Crow, Pine Siskin.

—A. Bell, J. Cartwright, M.H. Edwards, A.J. Erskine (compiler), Janet Erskine, A.E. Garwood, Ann Hutchison, A.E. Hyde, Isabel Hyde, W.G. Lamb, B. Lindgren, L.H. Lowther, Nora Mansfield, Helen Quilliam, D.R. Rogers, G.M. Stirrett, A. Strong, S. Teeple (Kingston Nature Club).

London, Ont. — December 31, 1955. Partly cloudy to cloudy, occasional snow flurries; wind, light, S.E.; temp. 18° to 22°. 38 observers in 12 parties.

Great Blue Heron, 2; Mallard, 3; Black Duck, 36; American Golden-eye, 118; Common Merganser, 10; Sharp-shinned Hawk, 2; Cooper's Hawk, 3; Red-tailed Hawk, 20; Bald Eagle, 2; Marsh Hawk, 2; Ruffed Grouse, 2; Bod-white, 11; Common Pheasant, 33; American Coot, 2; Mourning Dove, 158; Screech Owl, 2; Horned Owl, 4; Long-eared Owl, 5; Saw-whet Owl, 1; Belted Kingfisher, 11; Yellow-shafted Flicker, 1; Hairy Wood-

pecker, 10; Downy Woodpecker, 60; Horned Lark, 1; Blue Jay, 91; Crow, 2; Black-capped Chickadee, 278; White-breasted Nuthatch, 17; Red-breasted Nuthatch, 7; Brown Creeper, 13; Winter Wren, 6; Robin, 2; Golden-crowned Kinglet, 5; Cedar Waxwing, 8; Northern Shrike, 3; Starling, 203; House Sparrow, 860; Cardinal, 228; Evening Grosbeak, 3; Purple Finch, 6; Redpoll, 90; Pine Siskin, 112; American Goldfinch, 235; White-winged Crossbill, 25; Red-eyed Towhee, 1; Slate-colored Junco, 324; Tree Sparrow, 267; White-crowned Sparrow, 1; Swamp Sparrow, 2; Song Sparrow, 30; Snow Bunting, 426. Total, 51 species; 3,742 individuals. Seen recently in area: Dec. 30, Brown Thrasher; Jan. 1, Snowy Owl, White-throated Sparrow; Jan. 2, Red-winged Blackbird.

—James Leach, Migration Secretary.

Oshawa, Ont. (From west city limits of Oshawa, to Newcastle, on Lake Ontario, forming a radius of 20 miles from the center of Oshawa, to Lake Scugog to Pontypool). — Dec. 18, 1955, 8:00 a.m. to 4.00 p.m.; temp. 25° to 28°; light clouds in morning and afternoon, mostly clear and sunny, snow from 4 to 6 inches; wind W, 10 to 15 m.p.h. 20 observers in 5 parties. Total party hours 138, total miles in cars 260, on foot 22.

Great Blue Heron, 1; Mallard, 100; Black Duck, 600; Greater Scaup, 3; Common Golden-eye, 33; Buffle-head, 2; Old-squaw, 450; Common Merganser, 18; Red-breasted Merganser, 2; Cooper's Hawk, 1; Red-tailed Hawk, 1; Red-shouldered Hawk, 1; Pigeon Hawk, 2; Sparrow Hawk, 5; Ruffed Grouse, 3; Common Pheasant, 48; Great Black-backed Gull, 5; Herring Gull, 447; Rock Dove, 112; Mourning Dove, 3; Great Horned Owl, 5; Barred Owl, 1; Hairy Woodpecker, 10; Downy Woodpecker, 20; Horned Lark, 4; Blue Jay, 35; Crow, 21; Black-capped Chickadee, 136; White-breasted Nuthatch, 7; Brown Creeper, 2; Northern Shrike, 12; Starling, 333; House Sparrow, 399; Eastern Meadowlark, 1; Cardinal, 1; Evening Grosbeak, 70; Purple Finch, 4; Pine Grosbeak, 4; Redpoll, 70; Pine Siskin, 23; American Goldfinch, 155; Slate-colored Junco, 101; Tree Sparrow, 203; Swamp Sparrow, 1; Song Sparrow, 3; Snow Bunting, 30. Total, 47 species, 3,489 individuals.

—Miss C. Abbott, A. Bunker, Miss E. Bunker, Miss A. Carruthers, F. Dilling, R. Fleming, Miss B. Henry, F. Ireson, Mr. Laird, B. Neal, G. Owen, D. Rice, G. Scott, A. Stasko, Mr. and Mrs. K. Sands, L. Sturch, J. Theberge, T. Tozer, R. Tozer (Oshawa Naturalists Club).

Ottawa, Ont. (7½-mile radius). — December 26, 1954, 8.00 a.m. to 4.30 p.m.; intermittent sunshine; temp. 10-15°; wind W, 10-15 m.p.h.; 8-10 in. of snow. 28 observers in 9 parties. Total party hours, 57¾; total party miles, 327½ (54 on foot, 273½ by car).

Black Duck, 2; Am. Golden-eye, 172; Am. Merganser, 20; Sharp-shinned Hawk, 1; Red-shouldered Hawk, 1; Sparrow Hawk, 1; Ruffed Grouse, 8; Hungarian Partridge, 14; Ring-necked Pheasant, 9; Glaucous Gull, 1; Rock Dove, 101; Great Horned Owl, 2; Snowy Owl, 2; Hairy Woodpecker, 5; Downy Woodpecker, 9; Horned Lark, 3; Canada Jay, 2; Blue Jay, 24; Am. Crow, 7; Black-capped Chickadee, 100; White-breasted Nuthatch, 7; Brown Creeper, 2; Am. Robin, 4; Northern Shrike, 4; Starling, 2,659; House Sparrow, 2,140; Bronzed Grackle, 1; Evening Grosbeak, 70; Pine Grosbeak, 60; Hoary Redpoll, 3; Common Redpoll, 132; Pine Siskin, 6; Tree Sparrow, 2; Snow Bunting, 689. Total, 34 species; 6,263 individuals. Seen in area: Dec. 27, Screech Owl; Dec. 25, Barred Owl.

—H. Anderson, Miss A. Banning, J. Bird, Mr. and Mrs. A.G. Bland, A.E. Bourguignon, Miss S. Clark, Mrs. F.W.G. Clark, Miss M. Flynn, Dr. and Mrs. C. Frankton, Mr. and Mrs. R.E. Frith, W.E. Godfrey, J.W. Groves, Mrs. S.D. Hemsley, Miss V. Humphreys, H. Lloyd, D.A. MacLulich, B. Millman, P. Millman, E. Mills, F. Munro, Miss V. Ross, D.B.O. Savile, Mr. and Mrs. J.E. Tener (Ottawa Field-Naturalists' Club).

Pakenham, Lanark Co., Ont. — Dec. 29, 1955, 8.30 a.m. to 4.00 p.m.; sunny with a few cloudy periods during day; temp. 8° to 18°; light west wind; 2 inches of snow. 4 observers (25 miles by car, 12 miles on foot).

Ruffed Grouse, 2; Ring-necked Pheasant, 3; Pileated Woodpecker, 1; Hairy Woodpecker, 2; Downy Woodpecker, 3; Blue Jay, 11; Black-capped Chickadee, 15; White-breasted Nuthatch, 4; House Sparrow, 52; Evening Grosbeak, 1; Pine Grosbeak, 10; Common Redpoll, 84; Pine Siskin, 2; American Goldfinch, 14; Snow Bunting, 10. Total: 15 species, 247 individuals.

—J.S. McGiffin, R.M. McKenzie, Edna G. Ross, Verna M. Ross.

Peterborough, Ont. (Jackson Park, Lily Lake, Green Hill, Little Lake, Otonabee R., Nassau, Warsaw Rd.; Chemong Park, Bridge-north; Burnham Park, Rifle Range; lower Otonabee River, Crawford Grove; Cavan Swamp. Open farmland, 54%; marsh, 23%; water, 4%; mixed woods, 13%; deciduous

woods, 2%; coniferous woods, 4%). — December 26, 9 a.m. to 5 p.m.; sunny, bright, and clear; temp. 10° to 20°; wind NW, 5-15 m.p.h.; 1" to 2" light snow; lake frozen; river frozen except in stretches where water flowed swiftly. 25 observers in 6 groups. Total party hours, 28; total party miles, 98 (80 by car; 18 on foot).

Pintail, 1; Am. Golden-eye, 3; Am Merganser, 9; Red-breasted Merganser, 1; Rough-legged Hawk, 1; Sparrow Hawk, 2; Ruffed Grouse, 6; Rock Dove, 42; Hairy Woodpecker, 14; Downy Woodpecker, 12; Pileated Woodpecker, 3; Blue Jay, 22; Canada Jay, 1; Am. Crow, 2; Black-capped Chickadee, 143; White-breasted Nuthatch, 6; Northern Shrike, 1; Common Starling, 36; House Sparrow, 167; Pine Grosbeak, 4; Pine Siskin, 30; Evening Grosbeak, 200; Am. Goldfinch, 85; Tree Sparrow, 73; Snow Bunting, 35. Total species, 25; total individuals, 949.

—L. J. McKeever and F. R. Pammett, compilers (Peterborough Nature Club).

Rutherglen, Ont. (From township of West Ferris, villages of Bonfield and Rutherglen, areas around Lake Nipissing and Pimisi Bay, rivers Kaipuskong, Mattawa, Amable du Fond, and Ottawa, to town of Mattawa; open farmland 10%, mixed second growth forest 50%, marshes and bogs 5%, lakes and rivers 15%, settlements 20%.) — Dec. 28, 7:45 a.m. to 4:15 p.m.; blue sky to partly cloudy; temp. —24° to 16°; wind E veering to SW, W. E, 2-5 m.p.h.; ground covered with 8-10 inches soft powdered snow; all fresh water except rapids and the Ottawa River frozen. 2 observers. Total hours 16 (14½ on foot, 1½ by car); total miles 62 (17 on foot, 45 by car).

American Golden-eye, 3; American Merganser, 2; Canada Goose, 2; Pileated Woodpecker, 1; Hairy Woodpecker, 14; Downy Woodpecker, 3; Canada Jay, 2; Blue Jay, 15; Raven, 2; American Crow, 2; Black-capped Chickadee, 49; Brown-headed Chickadee, 1; White-breasted Nuthatch, 2; Red-breasted Nuthatch, 3; Common Starling, 8; Evening Grosbeak, 44; Common Purple Finch, 1; Pine Grosbeak, 14; Pine Siskin, 3; American Goldfinch, 2. Total, 20 species, about 173 individuals.

—Hazel Petty, Louis de Kiriline Lawrence, compiler (Nipissing Field-Naturalists).

Sault Ste. Marie, Ontario and Michigan. (The Canadian side of St. Mary's River and the waterfront on the American side). — December 27, 1955, 7 a.m. to 4.30 p.m.; temp. —1° to 18°; wind east, 8 m.p.h.; overcast with sunny intervals. 11 observers in 6 parties. Total party hours, 11 (1 on foot, 10 by car); total party miles 47 (2 on foot, 45 by car).

Am. Golden-eye, 3; Am. Merganser, 33; Herring Gull, 9; Snowy Owl, 1; Great Gray Owl, 1; Yellow-shafted Flicker, 3; Pileated Woodpecker, 2; Canada Jay, 1; Blue Jay, 11; Common Raven, 2; Am. Crow, 1; Black-capped Chickadee, 30; White-breasted Nuthatch, 1; Common Starling, 74; Northern Shrike, 1; House Sparrow, 7; Evening Grosbeak, 29. Total, 17 species; 209 individuals. —Dr. G.H. Bergold, R. Dennison, Mrs. Iola Fountain, Mrs. N. Henderson, Miss B. Jeffery, Ken Loftus, Miss H. Nattress, Otto McNaughton, J.D. McPhail, Dr. G. Stehr (compiler), Joseph Thomson.

Toronto, Ont. (Area within thirty miles of Museum building, as in past years). — December 26, 1955; daybreak to sundown; ground snow-covered, creeks and ponds frozen; Toronto Bay mostly frozen; temperature 14° to 27° (8° to 12° in the suburbs); strong north wind; 120 observers in 26 parties (routes standardized over the years).

Great Blue Heron, 1; Mallard, 882; Black Duck, 646; Pintail, 1; Wood Duck, 1; Canvas-back, 1; Greater Scaup, 4,289; Lesser Scaup, 2; Am. Golden-eye, 214; Buffle-head, 63; Old-squaw, 673; Am. Merganser, 34; Goshawk, 2; Sharp-shinned Hawk, 1; Cooper's Hawk, 4; Red-tailed Hawk, 29; Red-shouldered Hawk, 1; Rough-legged Hawk, 5; Marsh Hawk, 1; Sparrow Hawk, 37; Ruffed Grouse, 8; Ring-necked Pheasant, 140; Virginia Rail, 1 (the 133rd species noted on the Toronto census in the 31 years the Brodie Club has been taking it); Coot, 1; Glaucous Gull, 2; Iceland Gull, 1; Great Black-backed Gull, 11; Herring Gull, 1,669; Ring-billed Gull, 168; Mourning Dove, 2; Screech Owl, 2; Horned Owl, 13; Long-eared Owl, 8; Short-eared Owl, 2; Saw-whet Owl, 4; Belted Kingfisher, 2; Yellow-shafted Flicker, 2; Pileated Woodpecker, 2; Hairy Woodpecker, 44; Downy Woodpecker, 105; Blue Jay, 118; Crow, 25; Black-capped Chickadee, 680; Hudsonian Chickadee, 1; White-breasted Nuthatch, 37; Red-breasted Nuthatch, 29; Brown Creeper, 15; Carolina Wren, 3; Robin, 4; Hermit Thrush, 1; Eastern Bluebird, 1; Golden-crowned Kinglet, 4; Cedar Waxwing, 1; Northern Shrike, 23; Starling, 2,617; House Sparrow, 2,228; Eastern Meadowlark, 11; Red-winged Blackbird, 9; Rusty Blackbird, 10; Bronzed Grackle, 1; Eastern Cowbird, 1; Eastern Cardinal, 132; Evening

Grosbeak, 46; Purple Finch, 13; Pine Grosbeak, 7; Hoary Redpoll, 5; Common Redpoll, 2,242; Pine Siskin, 814; American Goldfinch, 312; White-winged Crossbill, 51; Slate-colored Junco, 641; Oregon Junco, 8; Tree Sparrow, 970; Field Sparrow, 3; White-throated Sparrow, 4; Swamp Sparrow, 4; Song Sparrow, 48; Snow Bunting, 130. Total species, 78; total individuals, 20,323.

—P. Addison, W. Addison, J.L. Baillie (organizer and compiler), H. Barnett, J. Barnett, L. Barnett, D. Beacham, J. Beacham, O.D. Boggs, O.D. Boggs, Jr., D. Bryant, D. Burton, L. Butcher, R. Campbell, W. Campbell, G. Clark, C.H.D. Clarke, J. Clarke, W. Clarke, R. Corlett, L. Crawford, E. Damude, L. Damude, A. Dawe, M. Devitt, O. Devitt, F.H. Emery, A. Falls, B. Falls, T. Farley, J. Ferguson, B. Foster, C. D. Fowle, G. Francis, A. Gatti, B. Geale, D. Geale, J. Geale, C. Goodwin, J. Hallam, H. Halliday, M. Halliday, Paul Harrington, Peter Harrington, R. Hensall, C. Hoby, F. Hoover, C. E. Ireson, L. Jackman, R. James, F. Keim, R. Knight, G. Lambert, L. Langstaff, J. Large, H. Lawrence, B. LeVay, F. LeVay, J. LeVay, N. LeVay, R. Lindsay, F. Lovesy, H. Lumsden, M. Macdonald, J. Mackintosh, G. Malkin, K. Mayall, R. McCleary, D. McCowan, L. McDougall, W. McGregor, T. McIlwraith, I. Metcalfe, I. Millar, A. Millar, A. Mitchener, F. Mueller, M. Nourse, — O'Conner, P. Page, R. Pannell, J. Parker, R. Pepall, D. Perks, A. Reid, H. Richards, D. Ripley, R. Ritchie, R. Saunders, D. Scovell, M. Shelton, J. Sherrin, T. Shortt, B. Smith, Don Smith, Doug Smith, F. Smith, R. A. Smith, Ron Smith, W. Smith, H. Southam, D. Speirs, J. M. Speirs, R. Standfield, D. Sumner, M. Tasker, R. Tasker, E. Taylor, R. Taylor, C. Teetzel, R. Trowern, G. Van-tets, T. Warren, E. Wasserfall, W. Wasserfall, B. Wescott, D. A. West, J. D. West, Michael West, H. Whyte, W. Williams and J. Woodford (Members and friends of the Brodie Club).

Crescent Beach, B.C. (Parts of coast and bush between Crescent Beach, Ocean Park, and White Rock, including Nicomekl River at Elgin. White Rock pier, Semiahmoo Indian Reserve, and Manten's Nursery). — December 29, 1955, 8:15 a.m. to 4 p.m.; temp. 22° at sunrise; little wind; sunshine all day; sea calm. 7 observers in 2 parties, and 2 observers at feeding station all day. 30 miles by car and on foot.

Common Loon, 49; Red-throated Loon, 3; Holboell's Grebe, 2; Horned Grebe, 36; Western Grebe, 15; Brandt Cormorant, 8; Great Blue Heron, 5; Brant, (heard not seen); Mallard, 77; Pintail, 147 +; Green-winged Teal, 52; Baldpate, 2; Canvas-back, 15; Greater Scaup Duck, 117; Am. Golden-eye, 42; Barrow Golden-eye, 2; Buffle-head, 78; Old-squaw, 17; Harlequin Duck, 11; White-winged Scoter, 500 +; Surf Scoter, 450 +; Am. Scoter, 50; Am. Merganser, 4; Red-breasted Merganser, 13; Red-tailed Hawk, 1 (dark phase); Sparrow Hawk, 1; Ring-necked Pheasant, 1; Red-backed Sandpiper, 62; Glaucous-winged Gull, 260; Gull, 1 (Ring-billed?); Short-billed Gull, 3; Pigeon Guillemot, 3; Marbled Murrelet, 4; Short-eared Owl, 1; Belted Kingfisher, 1; Red-shafted Flicker, 3; Pileated Woodpecker, 2; Northwestern Crow, 30; Black-capped Chickadee, 39; Chestnut-backed Chickadee, 8; Winter Wren, 3; Bewick's Wren, 3; Varied Thrush, 5; Kinglet (sp. ?); Ruby-crowned Kinglet, 1; Northern Shrike, 1; House Sparrow, 40; Brewer's Blackbird, 18; Evening Grosbeak, 4; Pine Siskin, 20; Spotted Towhee, 8; Oregon Junco, 32; White-crowned Sparrow, 3; Fox Sparrow, 7; Song Sparrow, 21. Total, 53 species, 2 uncertain; 2,281 individuals. Northern Shrike first record in the 18th Christmas Bird Census for Surrey, B.C.

—M. W. Holdom, Miller Lougheed, Moira Neil, Wendy Neil, H. Newnhouse, John Simeon, Richard Simeon, Tom Stevens, E. E. Woodford.

Vernon, B.C. (West to Okanagan Landing, north to Buckerfield's Ranch, south to Rattlesnake Point, Kalomalka Lake, and east to Coldstream Ranch). — Dec. 26, 1955, 9.15 a.m. to 3.15 p.m.; overcast with fog in afternoon and steady rain beginning about 11 a.m.; wind light; 16 inches of snow; temp. 33°-39°; Okanagan and Kalomalka Lakes with shore ice, Swan Lake completely frozen. Fourteen observers in four parties.

Western Grebe, 1; Mallard, 114; Baldpate, 18; Lesser Scaup, 1; Common Golden-eye, 12; Buffle-head, 3; American Merganser, 9; Sharp-shinned Hawk, 3; Rough-legged Hawk, 1; Marsh Hawk, 2; Pigeon Hawk, 1; Sparrow Hawk, 5; European Partridge, 127; Pheasant, 385; American Coot, 641; Wilson's Snipe, 2; Herring Gull, 2; Rock Dove, 32; Mourning Dove, 37; Pygmy Owl, 1; Saw-whet Owl, 2; Belted Kingfisher, 2; Red-shafted Flicker, 50; Pileated Woodpecker, 1; Hairy Woodpecker, 1; Downy Woodpecker, 2; Horned Lark, 99; Steller's Jay, 6; American Magpie, 48; American Raven, 2; American Crow, 19; Clark's Nutcracker, 5; Black-capped Chickadee, 59; White-breasted Nuthatch, 2; Red-breasted Nuthatch, 3; Pygmy Nuthatch, 9; Dipper, 2; Winter Wren, 1; Robin, 72; Varied Thrush, 1; Western Bluebird, 12; Townsend's Solitaire, 5; Golden-crowned Kinglet, 5; Bohemian Waxwing, 72; Cedar Waxwing, 4; Northern Shrike, 5; Starling,

16; English Sparrow, 500; Red-winged Blackbird, 61; Brewer's Blackbird, 95; Evening Grosbeak, 253; House Finch, 3; Rosy Finch, 15; Common Redpoll, 603; Pine Siskin, 1; American Goldfinch, 89; White-winged Crossbill, 25; Slate-colored Junco, 2; Oregon Junco, 328; Tree Sparrow, 22; Harris's Sparrow, 2; White-throated Sparrow, 1; Song Sparrow, 36; Snow Bunting, 1. Total, 64 species; about 3,939 individuals.

—Miss K. Bartholomew, Mr. and Mrs. S. Condrashoff, J. T. Fowle, Miss T. Gabriel, J. Grant, J. Obana, F. Paul, J. Quirk, Dr. D. A. Ross, Miss B. Ross, J. Holmes, A.N. Humphries, B.A. Sugden (The North Okanagan Naturalists' Club).

REPORT OF COUNCIL AT THE SEVENTY-SEVENTH ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB, DECEMBER 7, 1955

Since the last Annual Meeting, there were five meetings of Council, all at St. Patrick's College: December 13, 1954, with 20 members present; February 14, 1955, with 14 members present; May 11, 1955, with 15 members present; October 12, 1955, with 19 members present; and November 18, 1955, with 17 members present.

Appointments were made for 1955 as follows:

Editor of the Canadian Field-Naturalist — Dr. H. A. Senn.
Business Manager of the Canadian Field-Naturalist — Mr. W. J. Cody.
Chairman of the Publications Committee — Dr. J. W. Groves.
Chairman of the Excursions and Lectures Committee — Mr. P. A. Ruddell.
Chairman of the Reserve Fund Committee — Mr. Hoyes Lloyd.
Chairman of the Special Lectures Committee — Dr. E. L. Bousfield.
Chairman of the Membership Committee — Mr. W. J. Cody.
Chairman of the Bird Census Committee — Mr. R. D. Harris.
Chairman of the Macoun Field Club Committee — Dr. E. L. Bousfield.
Chairman of the 75th Anniversary Committee — The Rev. F. E. Banim.
Representatives, Canadian Section, International Committee for Bird Preservation — Messrs. D. A. Munro and W. E. Godfrey.

Report of the Publications Committee

During the period December 1, 1954, to December 1, 1955, two numbers of Volume 68 and one number of Volume 69 of the Canadian Field-Naturalist were published, with a total of 132 pages. Papers, notes and reviews were distributed as follows:

	Papers	Notes	Reviews
Botany	3	1	—
Entomology	1	1	—
Herpetology	1	—	—
Invertebrate Zoology	1	1	—
Mammalogy	8	1	—
Ornithology	2	12	2
Miscellaneous	1	—	4

Seventeen maps and other illustrations were used.

The account of the geology of the Ottawa District being prepared by Dr. Alice E. Wilson under the suonsorship of the Club is well advanced. The manuscript is nearly completed; the Geological Survey is finishing the photographs, and Mr. John Crosbie of the National Museum is preparing some line drawings to appear in the text.

The stock of back numbers has now been removed from the Motor Building to new and more convenient quarters, where a reorganization will be carried out as soon as shelving is available.

Report of the Excursions and Lectures Committee

The business of the committee included selection of winter programs and summer excursions, the annual Dinner, the Newsletter, the management of the Study Groups, and finances. One new member, Miss Deborah Haight, was elected treasurer of the committee.

There were two all-day excursions, one to the Lodge at Beattie Point, Shirley Bay, the other to Pakenham, where more than 40 members toured the surrounding countryside and listened to talks by Dr. Alice Wilson and Miss Edna Ross. A Members' Night was held in March at the Ottawa Normal School, where 45 members enjoyed illustrated talks

on various topics. Over 80 members attended the Annual Dinner held in April, when Father Banim's account of his recent trip to Europe was greatly enjoyed by all. Exhibits were on hand showing various phases of the work of the Macoun Field Club.

It was decided to publish the Newsletter quarterly, and three issues of the 1955 season have appeared so far. This represents 26 pages of interesting and informative articles prepared by 15 members. Displays were made at most of the Audubon Screen Tours to advertise the Club and promote local membership. The Bird Group is the largest of the study groups, and enjoyed seven meetings at the home of Mr. and Mrs. A. E. Bourguignon.

Five early morning Bird Walks were held in the Dow's Lake area under the guidance of Messrs. A. E. Bourguignon, W. E. Godfrey, J. E. Smith, anad Rowley Frith. These were well attended by Club members and students of the Ottawa Normal School. About 35 members attended an evening excursion held at Stittsville in order to observe the Woodcock. The birds put on an excellent performance. The other study groups have also been active, particularly the Fern and Moss Groups.

Report of the Reserve Fund Committee

There have been no changes in the Reserve Fund since the last Annual Meeting.

Report of the Special Lectures Committee

Three Audubon Screen Tours completed the 1954-55 series:

January 14 — Secrets of the Sea, by G. Clifford Carl.

February 24 — Into the North Woods, by Tom and Arlene Hadley.

April 12 — Rhapsody in Bluegrass, by Walter Shackleton.

The following lectures of the current season complete the program for 1955:

October 14 — Paul Bunyan Country, by Walter J. Breckenridge.

November 3 — Newfoundland, by Dick Bird.

Report of the Membership Committee

No formal meetings were held. It was felt by the chairman that no membership campaign on a large scale should be undertaken until publication of the Naturalist was brought closer to the desired goal.

The most recent membership count is as follows:

	Individuals	Institutions	Honorary and Life
Ottawa	165	18	10
Canada (nonlocal)	217	58	—
U. S. A.	56	92	3
U. K.	1	8	1
Elsewhere	9	17	—
	448	193	14

Total 655

Paid-up Associate Members for 1955 33

Report of the Macoun Field Club Committee

The present committee consists of Miss V. Humphreys, Mr. J. S. Bleakney, and Mr. J. Darling, appointed by the National Museum; Mr. H. Groh, Mr. D. C. Maddox, and Mr. W. K. W. Baldwin, appointed by the Ottawa Field-Naturalists' Club; and the Chairman, Dr. E. L. Bousfield.

As in previous years, meetings were held at weekly intervals in the National Museum. The Senior group numbered 21 active members under the chairmanship of Eric Mills and with a committee of four. The Intermediate group of 28 and the Junior group of 23 were headed by Jim Ingles and John Scoggan, respectively.

The program for all three groups included 21 regular meetings, of which 7 were field trips to the Club's Lodge at Beattie Point, Willis' quarry and other nature trails around Ottawa. The meetings were well attended, and the Club is much indebted to members of the Museum staff, the O. F.-N. Club, and many interested persons who gave talks, conducted meetings, and provided leadership and transportation on the field trips. At the seventh annual birthday party, held in the National Museum on April 16, badges were presented to 23 new members, and prizes were awarded to the Junior and Intermediate winners of the attendance and merit game. These and other successful contestants were treated to a special party held in May at the home of the chairman.

On April 26, selected members made their first television production, highlighted by a film of a hike to the Lodge, and on February 22 still others staged a second successful per-

formance. Members also appeared on several other programs of the CBC series "Let's Go to the Museum." Activities also included the publication of two issues (numbers 8 and 9) of "The Little Bear," edited by Mr. Groh and Mr. Maddox, and ushering for the Audubon Screen Tour series at Glebe Collegiate. Exhibits of collections and hobbies of the members have been displayed at the annual banquet of the O. F.-N. Club and on other occasions. The Club has continued to correspond with former members, who are now spreading the ideals and aims of the Club to other parts of Canada.

Report of the Bird Census Committee

Results of the Christmas bird census in the Ottawa district and the Christmas Bird Census for all of Canada will be published in a forthcoming issue of The Canadian Field-Naturalist. [Editor's note: See p. 85 of this issue.]

Report of Special Committee for Celebration of the 75th Anniversary

In celebration of the Anniversary:
(a) All newspapers of the Capital area and the Canadian Press were given material upon which they could draw for articles. They were most generous of space, and the public of Ottawa was given several excellent accounts of the Club and its work.
(b) Murphy-Gamble's Department Store put one of their display windows at the disposal of the Club for the period November 1 to 6. An excellent display was made there, and there were also many exhibits on the ground-floor of the store.
(c) Honorary memberships were conferred on Dr. Alice Wilson, and on Mr. Herbert Groh.
(d) The Newsletter gave considerable space to the event.
(e) Over 100 persons attended the banquet which was held on November 8 in the Assembly Hall at Lansdowne Park. A splendid address was delivered by Prof. T. F. McIlwraith, Head of the Department of Anthropology at the University of Toronto and Curator of Anthropology at the Royal Ontario Museum of Natural History. This address will be published in The Canadian Field-Naturalist in commemoration of the occasion.
(f) Expenditures exceeded ticket receipts by approximately $40.00, but this was more than covered by a supplementary fund of over $80.00 contributed in commemoration of the event by members and friends of the Club.

W. K. W. Baldwin
President.
H. J. Scoggan
Secretary.

AN ERROR NOTED

Subscribers are advised to correct the name of the fifth president of the Ottawa Field-Naturalists' Club in the list on page 74 of the Canadian Field-Naturalist, Volume 69 (July-September issue, 1955). The entry should read: John Macoun.

NOTES

Birds wintering at Calgary (1954-55). — A Ross's *Chen rossi,* goose winutered on the Bow river and the former Inglewood sanctuary on the outskirts of Calgary. It accompanied a flock of about 15 Canada geese, all wild birds. While in the confines of Inglewood the geese fed from the hand making identification positive. On the river they were more wary. Although Ross's geese have been kept at Inglewod and at the Calgary Zoo I believe this is the first instance of the species voluntarily spending the winter in this latitude.

Warm water residues poured into the Bow from large industrial plants prevent the river from freezing over for a few miles east of Calgary and provide suitable wintering habtat for an increase number of species. At least six killdeer, *Charadrius vociferus,* wintered here during 1952-53. The winter of 1954-55, one killdeer was present. Mallards, *Anas platyrhynchis,* numbering thousands have yintered here for many years. In recent years they have been joined by increasing numbers of American goldeneyes, *Bucephala clangula,* and American mergansers, *Mergus merganser.* During winter of 1954-55 a baldpate, *Mareca americana,* also remained. — *W. RAY SALT, Univ. of Alberta, Edmonton.*

Western Flycatcher in Alberta.—During the summer of 1954 several nests of a species of flycatcher were found on the shale banks of Gorge Creek near the Alberta Government Biological Station which is situated at an altitude of over 5000 feet in the foothills of the Rockies about 20 m. west of Turner Valley, Alberta. No specimens were taken and the flycatcher was not positively identified. In 1955 three similar nests were found in the same locality. On July 31, David Boag, a biologist at the Station, found a dead flycatcher below one of the nests in which were dead young several days old. This adult female was preserved. On August 10, I collected an adult female and an immature male from a group of flycatchers along Gorge Creek. These specimens have been identified by W. E. Godfrey of the National Museum of Canada as Western Flycatchers *Empidonax difficilis difficilis*. The Western Flycatcher has not been previously recorded from Alberta; in fact the above records constitute a considerable extension of the range of the species northward as well as eastward. — *W. RAY SALT, Department of Anatomy, University of Alberta.*

Brown-headed Chickadees in the Gulf of St. Lawrence. — On October 27, 1955, when the S.S. "Mapledell" was in the Gulf of St. Lawrence, bound for Montreal, 2 chickadees arrived on board. With the help of Mr. Cleghorn of the Redpath Museum (McGill University) I subsequently identified them as Brown-headed Chickadees *(Parus hudsonicus)*.

They were first noticed about the bridge during the afternoon, the ship being then between West Point of Anticosti and Pointe des Monts. The weather at the time was overcast with light to moderate northerly wind.

In the evening I found one in the wheelhouse, and took him down to my room, where he spent the night, and in the morning the other one was still in the wheelhouse. I think the former was an adult, and the latter a young bird.

Both birds were remarkably tame and showed not the slightest fear of people. The one that was in my room frequently landed on my head or shoulder when flying about, and I had only to put my hand to either of them to get them to perch on my finger. My Chief Officer took a photograph of the young bird so perched. The bird was quite undisturbed by the camera about 10 inches in front of it.

The bird in my room slept in a corner under a book case. His head was tucked away somewhere. and his feathers all fluffed up so that he had the appearance of just a ball of feathers with a tail projecting at one part. The shape of the mass was almost perfectly spherical. The feathers on the back and breast of both birds (but especially the smaller one) were of very fine texture.

They both left the ship (in the river) on the forenoon of October 28.

In June, 1952, S.S. "Empress of France", in the Strait of Belle Isle, in misty weather, about 2 dozen White-winged Crossbills *(Loxia leucoptera)* were on board. I noted at the time the same lack of fear of people in these birds. Two which got inside the promenade deck perched quietly on my finger while I carried them to the open deck. — *E.F. AIKMAN, (Captain S.S. Mapledell).*

Richardson's Merlin nesting in Manitoba. — On May 5, 1955, while doing some work in the spruce woods sand-hills, some four miles E.S.E. of Aweme, a female Richardson's Merlin *Falco Columbarius richardsoni)* flew out of a dark clump of spruce and at once showed her displeasure at our presence by a brilliant display of air manoeuvers unequalled by any other bird I have seen. Aftr making each spectacular stoop and regaining height again she would suddenly hover and then slowly move forward with short but extremely rapid bent wing strokes, uttering a rather high pitched twittering cry as she did so. An old crow's nest some 17 feet up in a large spruce was soon located and while climbing the tree and examining the nest she repeatedly stooped at me, coming within a few feet of my head each time.

The old nest had been well renovated with small twigs around the edge and inner shredded poplar bark and grass for lining so that the nest was soft and comfortably warm. The four brownish eggs were well marked with darker blotches and wavy lines. Their approximate measurements are 39.5 mm. long by 32 mm. across.

I believe this is the first time Richardson's Merlin has been found nesting in Manitoba. My brother Evelyn and son Percy were co-finders of the nest. — STUART CRIDDLE, *Treesbank, Manitoba.*

Nesting of Golden Eagle on Vancouver Island. — Though there are several fall and winter records of the Golden Eagle *(Aquila chrysaëtos)* on Vancouver Island, nothing seems to have suggested breeding till recently. On September 15, 1950, while in the foothills far up the Oyster River my attention was drawn to the yelping notes of two Golden Eagles soaring high over the slashings. This note, so familiar from contact with breeding Goldens in the Rainbow Mountains and elsewhere, seemed at least suggestive. When on June 26, 1954, David Williamson of Campbell River called to get information re a suspected Golden Eagle nest near Upper Campbell Lake, his observations called for investigation. He had discovered the nest while cougar hunting; at that time he saw three young in the nest; they were moving about, were about the size of a half-grown Glaucous-winged Gull and whitish in color. I agreed to go with him later and advised that early August should be about right to see the young birds well feathered.

Thus on Aug. 1 I met Williamson near Campbell River, transferred to his hunting jeep and he drove back through the near-endless slashings to the eagle's mountain. Williamson had seen only one parent at any time and the bird seemed very wary; so we climbed the steep slope and following the timbered crest of the ridge approached the nest above it from the back. The nest was located in a big Douglas fir high on the steep southern face but was not visible from the road.

My companion leading, first reconnoitered with the 8 powers and reported two blackish young in the nest. We moved down a few yards to better view, but when I took over with the glasses I found the nest platform vacant; but at the base of the nest-heap was a blackish object which gave us much speculation. There was a small bright yellow spot near the top, another larger at the bottom, and a gleaming white spot in the middle, all of which at length resolved into the yellow bill and toes and white wing-spot of one of the young. At this stage of plumage advance the white showed on the OUTSIDE of the folded wing. The proportions in the picture, however, seemed fantastic. That a near-flight eaglet could appear so diminutive seemed almost beyond belief. The distance — and we were almost level with the nest — I judged about seventy-five yards and Williamson thought it much less. I can only ascribe the phenomenon to the sweep of distance across the valley, the large girth and great height of the nest tree, the probable bulk of the huge nest and our very considerable underestimate of the distance.

The youngster was in plain view, perched on a peg jutting from the lower edge of the bulky nest structure which appeared three or four times the height of the bird. The latter, appearing very black against the nest background, posed as though frozen on his perch; only a close watch with the glasses revealed that the yellow bill-spot changed relative position as the head was turned in slow motion.

While we were puzzling over our dimensions problem, another young eagle flapped into view and passed over the nest. It escaped the field of vision of Williamson who at the moment held the glasses, but I had a perfect eye view of the bird, noting its rather heavy immature flap, the white basal spot of the primaries and white base of tail. Doubtless this was one of the two seen in the nest on our first approach.

I now attempted to set up the camera for a telephoto shot at the nest and its one occupant, but on noisily removing a limb to get a view, the third eaglet launched itself on the wing and again showing the flight pattern of the other, flapped away in the opposite direction to disappear in a moment behind the timber. So photography failed; but doubtless this eyrie will be used in another year as it probably has in several of the past. I was disappointed not to hear the voices of these eaglets — for the nest notes of the Golden and Bald are utterly different — but even so I left the site without the slightest doubt as to the identity of these birds.

In November of this same year John Green of Courtenay reported that while deer-hunting in this same general area he saw two Golden Eagles feeding on the carcass of a bear. When questioned he declared he could see their "stockings" plainly in his rifle-scope. Probably two of the family of five at large in the region. — HAMILTON M. LAING, *Comox, B.C.*

Record of Willet for Vancouver Island. — As there seems no authentic record of the Western Willet *(Catoptrophorus semipalmatus inornatus)* for British Columbia and the

bird is relegated to the Hypothetical List of Munro and Cowan, 1947, it is of interest to record the taking of a specimen at Comox on January 26, 1950. The bird evidently intended wintering here as such a bird was described by Vincent Bracewell some weeks earlier, having been seen at the Slough near Courtenay. It was first seen by the writer January 25, on the Croteau Beach at about half tide. From old association there was no doubt of identity but efforts to get the bird failed. How next day it weathered the most terrific blizzard of this record winter of deep snow and extreme cold was not plain. There were no exposed beaches, the sludge and bay ice being too heavy to be moved out by the tide and feeding grounds were covered. But on the evening of the 26th with the first open beach shallows the willet returned again from westward and was shot near the foot of the bay. It proved an adult female in fair condition, its stomach well filled with crawfish. Specimen now in Laing collection. — HAMILTON M. LAING, *Comox, B.C.*

Unusual Horned Owl nesting. — On May 15, 1947, the local Vancouver Island district game warden, Mr. Rex Hayes, asked me to accompany him on an investigation of a report of a ground-nesting Horned Owl *(Bubo virginianus)* in the Oyster River region. The location was about twelve miles inland, south of the river and close to the power line then under construction. Turning north from the old Camp 3 Road we got particulars from the workman who had reported the nest, and soon as we spread out and combed the designated knoll, a horned own flushed ahead of us and we were in possession of the nesting site.

The nesting knoll was a slight raise in a large stretch of very flat, open burned country. For this was in the heart of the old slashings, and burned over in at least two devastating fires. There was little reforestation except to willow-clumps. The only real timber was in a swamp nearby where fire had failed to penetrate. The nest itself was at ground level in the low hollowed base of a burned-out Douglas fir stump. There was no vestige of lining and no apparent reason for the choice of site, except that at the time of incubation it would have been warm. The snaggy rim was a good windbreak and the charcoal walls absorbed a good deal of sun heat. Two half-grown young of slightly unequal size were in possession. The nest was fairly clean, with little evidence of food litter.

The second parent now appeared and the two perched close by in some rampikes and voiced disapproval, in the hoot, — one deep in tone, the other treble — the *meow,* and also a note so shrill as to resemble a whistle. While I was busy with camera equipment to beat oncoming rain, one parent, I judged the female, made repeated sorties against the warden's head necessitating some expert ducking. Had he turned his back no doubt she would have struck him.

It was evident now these mates were of different color, the larger and darker female being apparently black enough for good *Bubo v. saturatus* whereas the male seemed outside the color bounds of that race. There was also a lighter tone to the larger of the nest-mates. The larger one also did most of the bill-snapping and belligerent, fluffed-out posing.

Heavy wind and rain cut our observations short for the day. But that evening the workman phoned Hayes that the young owls were out of the nest, so next forenoon with a promise of better weather, we returned. We found the stump site empty and could find no sign of the parents. For an hour we circled the nest site extending the search and then one of the parents was routed from among some rampikes. Later we found the larger of the two young and then the other. These young during the night evidently had walked 150 yards in air line, doubtless much farther through the roughage and with a shallow ravine to cross. Dropping experiments showed that they had no use of the wings.

On this search we discovered the second of their interesting perches. Yesterday one bird had been seen to fly up to a fire-blackened stub and vanish. The binoculars showed that the fire had burned out a sizeable pocket on the side of the stub at an elevation of about twenty feet. The owl fitted so well into the pocket and the grey-and-black color scheme that even the camera lens failed to find him. Today about a hundred yards from the nest we found an unusual amount of white excrement below a small green fir. Doubtless their loafing tree. The greenery provided both shelter from the weather and seclusion, also a good view of the nest.

The point of main interest to the game branch was to discover the food of these

raptors in an area practically devoid of small mammals of use to them. So in our search we collected as many regurgitated pellets as we could find. They all contained bird bones that were judged blue grouse, mostly broken, even in the case of wing and leg. We noted that no hooting cocks could be heard from the nest site though the sound was on the air practically everywhere else. Though we saw no feather patches denoting pluckings near the nest, the workmen said they had come on some nearby. Evidently the grouse were plucked near where captured and the remains packed home whole or in part. A few feathers only were found at the nest. I could find no sign of mammal remains. So the warden used his .22 and the family came home to a place in the specimen collection. As an added check, Hayes later sent the pellets to the University of British Columbia laboratory where Dr. Ian McT. Cowan reported "blue grouse, 100 per cent".

— HAMILTON M. LAING, *Comox, B.C.*

A Harp Seal from the Leda Clay West of Hull, Quebec. — In August, 1954, Rolph Rolofs, a camper at Woodland Boys Camp, 23 miles (by road) west of Hull, found a string of seven vertebrae. He gave these to Pierre Taschereau, a counselor, who turned them over to Mr. D.C. Maddox, the Camp Geologist. Recently, Mr. Maddox and Mr. H. Groh handed the specimen to me for identification and recording. It represents dorsal vertebrae six to twelve of a harp seal, *Phoca groenlandica.* The bones are splendidly preserved and complete except for the tips of the neural spines and of four of the transverse processes. These tips were destroyed by erosion before discovery. Indurated clay holds the centra together and surrounds some of the neural arches, but otherwise the bones are exposed. They are from a moderate-sized animal and probably represent a young adult. The specimen has been presented to the National Museum, Ottawa, and bears catalogue number 8924.

Mr. Groh gives the locality, for the specimen, as on the north side of the Ottawa River, upstream from Woodland Boy's Camp, where a deep bay has been cut out of the farmlands, exposing a cliff of Leda Clay. Numerous round and flattened concretions are continually being eroded from this clay bed. Fossil shells, including *Saxicava rugosa,* are often found in or attached to the concretions. Apparently conditions here are like those east of Ottawa, near the mouth of Green's Creek, where similar concretions are continually weathering out of Leda Clay. Several species of fish and mammals have been reported from this Late Pleistocene clay, but the great majority of vertebrates from the Green's Creek locality, represent the little fish, *Malotus vellosus,* which is living today in the Gulf of St. Lawrence.

Among the first vertebrate fossils reported from the Leda Clay of the Ottawa Valley was the hind limbs of a seal, collected by Peter McArthur from nine miles east of Ottawa. E. Billings sent this specimen to Dr. Joseph Leidy who reported it in Proceedings of the Academy of Natural Sciences, Philadelphia, Vol. 8, pp. 90-91, 1856. In the Canadian Naturalist, Vol. 8, No. 6, 1878, J.W. Dawson described a specimen of harp seal, *Phoca groenlandica,* from the same area as the Billings specimen, and suggested that both belonged to the same species.

Other specimens of the harp seal have been collected from the Leda Clay at various localities. In 1889 Ruggles Wright and H. M. Ami collected most of the skeleton of a young harp seal from a sandy layer in Wright's brick yard just west of Hull, Que. Only fragments of the skull were secured but the left ramus of the lower jaw, with teeth, showed that it was a harp seal. Ami mentioned it in an article in the April, 1897, number of the Ottawa Naturalist. This specimen, Cat. No. 6830, N.M.C., is on exhibit in the National Museum. In the same case is a head, neck and fore limb of a martin, *Martes americana,* collected by Ami from the Leda Clay at Green's Creek.

In Bull. 123, Nat. Mus., Canada, pp. 259-61, 1951, I reported several specimens of white whale and other mammals, from Pleistocene deposits of the Ottawa and St. Lawrence River valleys. — *C. M. STERNBERG, Ottawa.*

Myrtle Warbler at Baker Lake, N.W.T. — A bird unknown to the Eskimos was identified by me, according to "Birds of Canada" by P. A. Tavernier, as being unmistakably a Myrtle Warbler, *Dendroica coronata.* The bird came into the Mission on May 14, 1955. He was very fond of flies and crumbs. — *FR. CHARLES CHOQUE, o.m.i., Catholic Mission, Baker Lake, N.W.T., via Churchill, Man.*

The White-winged Crossbills of Newfoundland. — The possibility that the White-winged Crossbills of Newfoundland might be subspecifically separable from *Loxia l. leucoptera* Gmelin of the mainland has been suggested by Noble (1919, p. 557) and by Aldrich and Nutt (1939, p. 38). Since I had already assembled a large series of these crossbills for study in another connection, it occurred to me to look into the matter of the Newfoundland population. Additional material was therefore borrowed until I had available 31 Newfoundland and 282 other specimens for comparison.

By a curious coincidence, both Noble and Aldrich and Nutt based their findings on two Newfoundland specimens each, in both cases an adult male and a juvenal male. The Aldrich-Nutt specimens are now in the collection of Carnegie Museum, and Noble's specimens were borrowed from the Museum of Comparative Zoology. In both cases the authors suggested that the Newfoundland population might prove to be significantly darker (in both the adult and juvenal plumages) than that of the mainland, although Noble was less confident of the significance of his limited material than were Aldrich and Nutt of theirs.

The juvenal plumage of the White-winged Crossbill gives the appearance of dark streaks on a pale background, due largely to the contrast between the dark centers and light edges of the individual contour feathers. In fresh, unworn juvenal plumage, these light margins are strongly washed with buffy, approximating on the underparts the Pale Orange-Yellow or Warm Buff of Ridgway (1912). With wear these light edgings are not only reduced by abrasion but bleached and faded to white (although this is usually adventitiously darkened with soot and dirt). The general effect is to make the bird appear darker, especially dorsally (where the dark shaft stripes are broader), both by the reduction of the light margins and the increased contrast of the dark centers with the bleached edges.

The Aldrich-Nutt juvenal specimen, taken September 1, is the most heavily worn (and consequently darkest appearing) bird in this plumage in the entire series before me. Noble's specimen, taken July 26, is only slightly less worn, and, in spite of Noble's statement to the contrary, is adventitiously darkened. There is much variation in the amount of wear exhibited by the juvenal feathers at the onset of the post-juvenal molt. As mentioned above, the Aldrich-Nutt specimen was taken September 1, and is very worn; it shows no feathers of the first winter plumage. On the other hand, a specimen from Wolfville, Nova Scotia, in Carnegie Museum had barely begun its post-juvenal molt on December 4, yet the juvenal feathers are much less worn than those of the Aldrich-Nutt bird. A specimen taken at Moose Factory, Ontario, on October 13 has large patches of the first winter plumage visible, yet the juvenal feathers appear scarcely worn at all.

Of four available juvenal males from Newfoundland, only one is in fresh plumage. This specimen is not darker than mainland birds in similar plumage. The darkest, by far, of the juvenal males before me was taken at Moose Factory on June 30, and is in fresh plumage.

The series of juvenal females is somewhat better. With six relatively unworn Newfoundland and six comparable mainland birds available, a slight difference in dorsal color is apparent. The pale edgings of the crown and interscapular region of the Newfoundland birds average somewhat whiter. However, one of the six, from Stephenville Crossing, Nfld., is an excellent match for Moose Factory birds, and there is much variation in both series. In summary, there appears to be no basis in the color of the juvenal plumage to warrant subspecific separation of the Newfoundland population of the White-winged Crossbill.

Turning now to the adults we find again that the slight tendency toward color differentiation in the Newfoundland birds is best expressed in the females. In adult males no geographic significance can be attached to the considerable variation of the shade of red or pink of the body plumage. Some mainland males exhibit a reduction of the black of the interscapular region to an extent not shown in any of the 11 Newfoundland males seen, but many mainland males equal and several exceed the Newfoundland birds in the extent of the black areas of the plumage.

The seven adult females available from Newfoundland are a brighter yellow-green on the upper parts than the great majority of females from elsewhere, although they can be matched by certain specimens from Alberta and Ontario. None of the seven is in the grayish plumage which is so common

in mainland females. This could easily, however, be a sampling accident, especially since the four brightest and most uniform of the Newfoundland females were all taken in January and February, 1917, at Grand Lake by the late A. C. Bent, and are presumably from the same flock. The three females from other localities are duller.

It would seem, then, that the minor average color differences observed are insufficient basis for the subspecific separation of the Newfoundland population of the White-winged Crossbill. It is interesting to note that these tendencies toward color differentiation are most apparent in the female, both in the adult and the juvenal plumage, and have nothing to do with the characters supposed by Noble and Aldrich and Nutt to be found in the males.

ACKNOWLEDGMENTS: Specimens were assembled for this study through the courteous co-operation of the following: William C. Dilger (Cornell University), Herbert Friedmann (U. S. National Museum), E. Thomas Gilliard (American Museum of Natural History), Raymond A. Paynter, Jr. (Museum of Comparative Zoology), and L. L. Snyder (Royal Ontario Museum).

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KENNETH C. PARKES,
Carnegie Museum,
Pittsburgh 13, Pennsylvania.

Records of two microtine rodents from the Quebec tundra. — A camp was established at Payne Lake, latitude 59°30'N., longitude 74°W., in the Ungava region of northern Quebec, from July 27 to August 4, 1954, in connection with an investigation of the Ungava caribou. I was assisted in this study by Mr. Jacques Normandin, Quebec Department of Game and Fish. Payne Lake is situated in typical tundra environment approximately 100 miles north of tree-line which occurs along the banks of the Leaf River.

A few Museum Special traps were set out several evenings on the tundra near the camp and a small number of microtine rodents were secured and preserved. The collection consisted of three red-backed voles *(Clethrionomys gapperi ungava)*, one bog lemming *(Synaptomys borealis innuitus)*, and two collared lemmings *(Dicrostonyx hudsonicus)*. The sub-specific determinations are made solely on a geographical basis. The specimens were donated to the National Museum of Canada.

The capture of the red-backed vole and the bog lemming at Payne Lake extends the known range of these two rodents about 200 miles northwest from the Fort Chimo area, according to the recent range maps presented by Hall and Cockrum (1953). Fort Chimo is situated in the forest region.

It is interesting to note that in northwestern Quebec the red-backed vole has invaded the tundra habitat which is occupied by the tundra red-backed vole *(Clethrionomys rutilus)* elsewhere in northwestern North America. It is postulated that the forest species *C. gapperi* has been able to colonize the Quebec tundra habitat because the northwestern tundra *C. rutilus* was not present to compete for the ecologic niche.

Only one red-backed vole examined was normal in coloration, the pelage of the other two were in the "grey" phase, which seemed to be the commoner coloration in this region.

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Hall, E. Raymond and E. Lendell Cockrum, 1953. A Synopsis of the North American Microtine Rodents. Univ. Kansas Publ., Mus. Nat. Hist., 5(27):373-498. — *A. W. F. BANFIELD, Canadian Wildlife Service, Ottawa, Ontario.*

Record of Perch, *Perca flavescens*, from Great Slave Lake, N.W.T. — On November 28, 1954, a single specimen of yellow perch, *Perca flavescens* (Mitchill) was caught by a one and one-half inch mesh gill-net in Great Slave Lake at 62° 7′ N. lat., 115° 55′ W. long. The northern limit of perch was previously reported as Lake Athabaska. The specimen was a three and one-half year old mature male with a standard length of 11.9 cm. and a weight of 28.9 gm. — DONALD C. SCOTT, *Central Fisheries Research Station, Winnipeg.*

FINANCIAL STATEMENT OF THE OTTAWA FIELD-NATURALISTS' CLUB, DECEMBER 7, 1955

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Assets		Liabilities	
Bal. in Bank, Dec. 1/55	2,837.30	Audubon Screen Tours, guarantee	750.00
Bills receivable	90.11	Bills outstanding	49.06
Lodge, estimated value	200.00	Balance	2,328.35
	$3,127.41		$3,127.41

Receipts			Expenditures	
Bal. in Bank, Nov. 26/54		3,745.57	Can. Field-Nat. (3 nos.)	1,584.00
Fees:			Illustrations	222.81
Current	1,433.53		Separates	423.00
Advance and Arrears	232.89		Postage & Stationery	203.29
Assoc.	35.00	1,701.42	Business Manager's Honorarium	15.00
Separates		340.39	Excursions & Lectures Comm.	100.00
Single & Back Numbers		214.72	Newsletter (2 nos.)	67.25
75th Anniversary (net)		43.99	Illustrations Wilson Book	225.00
Miscellaneous		41.65	Bank Discount	22.50
			Foreign Exchange	11.10
			Miscellaneous	81.57
			Audubon Screen Tours (net)	294.92
			Bal. in Bank, Dec. 1/55	2,837.30
		$6,087.74		$6,087.74

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Assets		Liabilities
Hydro-Electric Power Comm. Ont., Bonds, 3%	3,000.00	NIL
Bal. in Bank, Dec. 1/55	570.51	
	$3,570.51	

Receipts		Expenditures	
Bal. in Bank, Nov. 26/54	475.80	Rent safety deposit box	5.00
Bank interest	9.71	Bal. in Bank, Dec. 1/55	570.51
Bond interest	90.00		
	$575.51		$575.51

PUBLICATION FUND

Assets		Liabilities
Hydro-Electric Power Comm. Ont., Bonds, 3%	1,500.00	NIL
Bal. in Bank, Dec. 1/55	346.46	
	$1,846.46	

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Bal. in Bank, Nov. 26/54	295.43		
Bank interest	6.03	Bal. in Bank, Dec. 1/55	346.46
Bond interest	45.00		
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NEW PLANT RECORDS FOR NORTHERN ALBERTA AND SOUTHERN MACKENZIE DISTRICT[1]

W. J. Cody

Botany and Plant Pathology Laboratory, Ottawa, Ontario

Received for publication September 16, 1955

The specimens upon which this paper is based were collected during the years 1949-53 as part of a co-operative project between the Canada Department of Agriculture and the Canada Defence Research Board.

In 1949 the author, with Mr. J. B. McCanse, was based at Yellowknife on the north shore of Great Slave Lake. In 1950 he was stationed at Fort Smith on the Slave River at the Alberta — Mackenzie District border. Here he was accompanied by Mr. C. C. Loan. In 1951 Mr. W. H. Lewis worked at Hay River on the southwest shore of Great Slave Lake and in 1953 the author, accompanied by Mr. R. L. Gutteridge, made short stops at Lac la Biche and Fort McMurray in northern Alberta.

The main localities from which specimens are cited are as follows:

1949 :

Yellownife	62°27′N, 114°22′W
Outlet of Prosperous Lake	62°33′N, 114°13′W
Prelude Lake	62°35′N, 114°00′W
Dome Lake	62°45′N, 113°15′W
Snare River Power House	63°33′N, 115°55′W
Indin Lake	64°17′N, 115°12′W
Beaverlodge Lake	64°44′N, 112°12′W
Gunbarrel Inlet, Great Bear Lake	65°37′N, 118°30′W
Contact Lake	66°00′N, 117°20′W
Port Radium, Great Bear Lake	66°05′N, 118°03′W

1950 :

Ft. Smith	60°00′N, 111°53′W
Seven Mile Lake, 27 miles west of Ft. Smith	60°02′N, 112°38′W
Little Buffalo River, 32 miles west of Ft. Smith	60°02′N, 112°48′W
Salt Plain, west of Ft. Smith	60°03′N, 112°25′W
Salt River	60°06′N, 112°15′W
Ft. Fitzgerald, Alta.	59°52′N, 111°37′W
Ft. Chipewyan, Alta.	58°42′N, 111°10′W

1951 :

Lower Hay River	60°51′N, 115°42′W
Alexandra Falls on Hay River	60°30′N, 116°17′W
Louise Falls on Hay River	60°30′N, 116°13′W
Brabant Island, Great Slave Lake	61°03′N, 116°35′W
Long Island, Great Slave Lake	61°43′N, 114°53′W
Big Island, Great Slave Lake	61°05′N, 116°40′W
Moraine Point, Great Slave Lake	61°36′N, 115°38′W

1953 :

Lac la Biche, Alta.	54°46′N, 111°58′W
Fort McMurray, Alta.	56°44′N, 111°23′W

Complete sets of the specimens collected during these years are preserved in the Herbarium of the Department of Agriculture at Ottawa (DAO). A few sheets preserved in the Herbarium of the National Museum of Canada (CAN) are cited for purposes of discussion.

Unless otherwise stated, the collection numbers cited throughout this paper are those of the author.

OPHIOGLOSSACEAE

Botrychium multifidum (Gmel.) Rupr. var. multifidum

MACK : very rare in rich black sandy soil in sod among scrub *Salix* spp., Ft. Smith, *4768*.

Previously known in the Mackenzie Basin only at Sand Point on Lake Athabaska and at Ft. Simpson. This is the second record for Mackenzie District.

[1] Contribution No. 1491 from the Botany and Plant Pathology Division, Science Service, Canada Department of Agriculture, Ottawa, Ontario.

The Canadian Field-Naturalist for April-June 1956 (Can. Field Nat. 70: 69-100. 1956) was issued April 5, 1957.

POLYPODIACEAE

DRYOPTERIS FRAGRANS (L.) Schott var. REMOTIUSCULA Komorov

ALTA: mossy areas along rocky exposed ledges; common; Caribou Island, Slave River 59°43'N, 111°31'W, *Loan 26.*

Var. *remotiuscula* has apparently not previously been recorded for Alberta.

POLYPODIUM VIRGINIANUM L.

MACK: scattered in crevices in rock hillside, Yellowknife, *3016;* rare in deep moss in protected hollow on rocky hillside, Latham Island, Yellowknife Bay, *2316;* rare in hollow of rock, small island off east shore of Yellowknife Bay, 8 miles south of Yellowknife, *2434;* very scattered, rooted in moss in hollow of rocky hillside, Snare River Power Station, *2617;* rooted in moss among boulders, Beaverlodge Lake, *2733;* rare in shallow soil among boulders on hillside Gunbarrel Inlet, Great Bear Lake, *2848.*

Not previously recorded north of Great Slave Lake.

EQUISETACEAE

EQUISETUM PALUSTRE L.

MACK: common in exposed mud ditch, Lower Hay River, *Lewis 619;* common in moist sand, Hardisty Island, Great Slave Lake, *2919.*

Recorded by Hooker (1829-1840) as "to the shores of the Arctic Sea" but no collections have previously been reported from the shores of Great Slave Lake.

EQUISETUM HYEMALE L. var. AFFINE (Engelm.) A.A. Eaton (*E. prealtum* Raf.)

MACK: scattered in sand in the *Pinus banksiana* forest and in open areas just west of Ft. Smith, *3668* and *3739;* in sand in cutover scrub area, rare, Bell Rock, 8 miles west of Ft. Smith, *3733;* common along exposed sandy riverbank, Old Settlement, Hay River, *Lewis 682.*

Reported by Raup (1947) from the Upper Slave River and from Simpson. The above mentioned specimens represent the second report of this species for Mackenzie District.

SELAGINELLACEAE

SELAGINELLA RUPESTRIS (L.) Spring.

ALTA.: rare in patches in very shallow soil over igneous rock, Ft. Fitzgerald, *4427* and *4432.*

This is an extension of range of some 75 miles north and northwest from Lake Athabaska.

ISOETACEAE

ISOETES MURICATA Dur. var. BRAUNII (Dur.) Reed

MACK: rooted in muck in 2 ft. water, rare, bay north of town, Yellowknife, *3500;* in fine sand in 15 inches water, Jackfish Lake, Yellowknife, *3273;* fairly common in 1—2 ft. water, north end of Kam Lake, Yellowknife, *3536;* fairly common in 18 inches water, sand bottom, mouth of Yellowknife River, *3278.*

Not previously recorded for the area between Lake Athabaska and Great Bear Lake; the second collection for Mackenzie District.

PINACEAE

PINUS BANKSIANA Lamb.

MACK.: trees to 30 ft. in crevices of igneous rocky hillsides and sandy gravel hillsides throughout the area, Yellowknife, *2098* and *2379;* trees to 25 ft. scattered in shallow soil on rock hillside, Yellowknife River Power House, *3309;* very common in crevices on rocky hillside, Dome Lake, *3186;* occasional in shallow soil on rocky hillside, Snare River Power Station, *2615;* sand ridges on east side of Mackenzie River approximately 26 miles due southeast of Fort Norman, 64°41'N, 124°51'W, *Angus Sherwood,* Sept. 1, 1953.

A full discussion of the distribution of this species in Mackenzie District is given by Raup (1947). Prevous records from north of Great Slave Lake are, however, not substantiated. Mr. Angus Sherwood, who is postmaster at Norman Wells, has written the following interesting information regarding his collection: "... These specimens are from a young tree, 6" in diameter at 1' above the ground surface. Time did not allow me to walk back from the lake to the sand ridges where the old growth trees stand. The limit of growth for the mature trees is about 16" dia. taken above the root swell at the butt. There are several groves of these old trees on the well drained sand ridges... I have checked with many natives, who as you know are very observant and all have told me that these pines are the last..." The known northern limit of Jack Pine in Mackenzie District would thus appear to be 64°41'N.

JUNIPERUS COMMUNIS L. var. DEPRESSA Push (*J. communis* L. var. *montana* sensu Raup pro parte).

MACK: fairly common in shallow soil on rock hillside, Indin Lake, *3367;* scattered in shallow soil on rocky hillside, Gunbarrel Inlet, Great Bear Lake, *2847;* sand muck, Sawmill Bay, Great Bear Lake, *Corcoran 13;* along Brock R. approx. 8 miles directly east

of its mouth [south end of Darnley Bay, Arctic Coast], *Ross Mackay s.n.* 1951.

Reported by Cody and Chillcott (1955) from Matthews Lake; the map in Raup (1947) shows a lack of collections of *Juniperus communis* from the east end of Great Bear Lake and also between Great Bear Lake and Great Slave Lake. The Brock River collection is apparently an extension of range of some 450 miles eastward from near the Mackenzie River Delta and north from the south shore of Great Bear Lake.

JUNIPERUS HORIZONTALIS Moench
MACK.: prostrate, trailing in crevice on rock hillside, common on some hillsides, Indin Lake, *3371;* Yellowknife *2054, 2072, 2209* and *2472.*

Preble (1908) reports *Juniperus sabina* as extending "throughout the forested belt," but Raup (1947) recorded that he had only seen specimens from Wrigley and Nahanni Mt. below Great Slave Lake.

TYPHACEAE

TYPHA LATIFOLIA L.
MACK: occasional on lakeshore in 1 ft. water, Seven Mile Lake, 27 miles west of Ft. Smith, *4671;* common on exposed shore of river West Channel, Hay River, *Lewis 1123;* common in shallow water rooted in ooze, Rat Lake, Yellowknife, *3559.*

Raup (1947) reports this species as "noted in Fl. Bor.-Am. as occurring 'Throughout Canada to Fort Franklin,'" but goes on to say that there is no other evidence of its presence on the upper Mackenzie. In addition to the specimens cited above, several sterile stands were observed in the vicinity of Yellowknife, as well as a sterile stand just below the power dam in the Yellowknife River north of Prosperous Lake (62°40'N, 114°15'W). The record of the presence of *Typha latifolia* in Mackenzie District is now substantiated.

SPARGANIACEAE

SPARGANIUM MINIMUM (Hartm.) Fries
MACK: dried up pond, Ft. Smith, *Loan 36;* rooted in ooze in small bay of Fame Lake, Yellowknife, *3558.*

Raup (1947) cited a Mackenzie River specimen by Onion and stated that this specimen was the only record for the species north of Lake Athabaska. The specimens listed here are apparently the first Mackenzie District collections with specific locality data.

POTAMOGETONACEAE

POTAMOGETON FILIFORMIS Pers. var. BOREALIS (Raf.) St. John
MACK: in 15 inches water rooted in fine sand, rare, Jackfish Lake, Yellowknife, *3272;* rooted in muck in 2 ft. water in bay on north side of town, Yellowknife, *3499;* fairly common rooted in sand in 1—2 ft. water at north end of Kam Lake, Yellowknife, *3534.*

Previously known in Mackenzie District from only two collections: Fairchild Pt. and N.W. shore of Great Slave Lake. It is certainly expected to occur along the upper Mackenzie River.

POTAMOGETON FOLIOSUS Raf. var. MACELLUS Fern.
MACK: rooted in mud in shallow lake by old townsite, Yellowknife, *3552* and *3555.*

Previously known from Wood Buffalo Park, Alta. and Great Bear Lake (Raup 1947).

POTAMOGETON ALPINUS Balbis var. TENUIFOLIUS (Raf.) Ogden
MACK: rooted in sand in 2—3 ft. water at north end of Kam Lake, Yellowknife, *3533;* rooted in mud in shallow lake by old townsite, Yellowknife, *3551, 3554* and *3556;* in pond of small creek in 15 inches water, rare, Indin Lake, *3471;* rooted in deep ooze in 15 inches water at edge of small lake, Indin Lake, *3454.*

Not previously recorded in the area between Lake Athabaska and Great Bear Lake (Raup 1947).

ALISMACEAE

SAGITTARIA CUNEATA Sheldon
MACK: occasional at edge of river suspended in 1 ft. water, Lower Hay River, *Lewis 968;* sagittate leaves mostly floating, rooted in muck of Baker Creek at Giant Mine, Yellowknife, *3484.*

Previously collected only once in Mackenzie District, and that in the Paleozoic country on the northwest shore of Great Slave Lake.

ALISMA TRIVIALE Pursh (*A. plantagoaquatica* L. subsp. *brevipes* (Greene) Samuels.)
ALTA: river shore in wet silt, rare, Ft. Fitzgerald, *Loan 205.*

This extension of range northward from Chipewyan on Lake Athabaska to just south of the Alberta—Mackenzie border would lead us to suspect that it might also be found in southern Mackenzie District.

GRAMINEAE

BROMUS INERMIS Leyss
ALTA: common in disturbed ground by railway yards, Lac la Biche, *6976;* MACK: occasional in exposed dried pond, Airport, Lower Hay River, *Lewis 735.*

This introduced grass is evidently spreading northward into our area. It is recorded both by Groh (1949) and Turner (1949). New to the flora of Mackenzie District.

GLYCERIA GRANDIS S. Wats.
MACK: scattered along dried-up slough south of town of Ft. Smith, *4515;* moist clay of river bank, Little Buffalo River, 32 miles west of Ft. Smith, *4758;* moist edge of exposed pool, Lower Hay River, *Lewis 1111B;* scattered in clumps in moist ground by bay, Yellowknife, *3056;* by small lake near old townsite, rare, Yellowknife *3557.*

The florets of No. *4758* are a pale yellowish green rather than purple as in the typical plant; this specimen should therefore be referred to forma *pallescens* Fern. No. *3557* has some spikelets measuring up to 8 mm. in length and is thus approaching var. *komarovii* Kelso. Raup (1947) records only one collection from Mackenzie District (Resolution). The species reaches its northern limit on the north shore of Great Slave Lake and has apparently not previously been recorded from east of the Paleozoic boundary in our area.

GLYCERIA PULCHELLA (Nash) K. Schum
MACK: rare in wet sand of roadside ditch, Yellowknife, *2678;* rare in shallow water among sedge on north shore of Latham Island, Yellowknife, *3081;* scattered in moist gravel by stream, west side of Kam Lake, Yellowknife, *2987B.*

Apparently restricted to areas in close proximity to the main Mackenzie River system in Mackenzie District; not previously recorded from east of the Paleozoic boundary.

GLYCERIA BOREALIS (Nash) Batchelder
ALTA: scattered in moist drying-up muskeg ½ mile south of Ft. Smith, N.W.T. in Alberta, *Loan 201.*

This is a northward extension of range from the Upper Slave River lowland locality cited by Raup (1936). Its presence here just south of the Alberta—Mackenzie border indicates that it will almost certainly be found in Mackenzie District.

PUCCINELLIA HAUPTIANA (Krecz.) Kitagawa
ALTA: shallow soil over igneous rock, rare, Ft. Fitzgerald, *4435.*

This is a Siberian species which extends through Alaska and Yukon. The only other record for Alberta is that of Swallen (1944) from Banff.

SCOLOCHLOA FESTUCACEA (Willd.) Link (*Fluminia festucacea* (Willd.) Hitch.)
MACK: exposed shore, southwest exposure, rare, Big Island, Great Slave Lake, *Lewis 1101.*

Recorded by Fernald (1950) as "s. Mackenz. and B.C., s. to Ia." but Raup (1936) does not list any specimens from farther north than the Upper Slave River lowland in northern Alberta. The species was certainly expected to occur in Mackenzie District.

POA INTERIOR Rydb.
MACK: clumps in rock crevice, Prosperous Lake, *2866* (det. Swallen); common in sand in open area east of Ft. Smith, *4054;* scattered in moist sand on south slope of Slave River, Ft. Smith, *4528;* moist peat, exposed, sparse, Moraine Point, *Lewis 487.*

Not recorded by Raup (1935, 1936) for either Wood Buffalo Park or the Athabaska—Great Slave Lake region; apparently new to the flora of Mackenzie District.

POA STENANTHA Trin.
MACK: clumps, fairly common in pure sand, Yellowknife, *2376* (det. Swallen); fairly common in shallow soil over rock, Joliffe Island, Yellowknife, *2462* (det. Swallen).

Not previously recorded from Mackenzie District.

POA CUSICKII Vasey
ALTA: clumps in shallow soil over igneous rock, Government Dog Camp, Chenal de Quatre Fourches (58°38'N, 111°20'W), *3655.*

Apparently not previously recorded from northern Alberta.

DISTICHLIS SPICATA (L.) Greene var. STRICTA (Torr.) Beetle (*D. stricta* (Torr.) Rydb.)
MACK: rather rare in wet clay of roadside ditch, Salt Plain west of Ft. Smith, *4570.*

Previously known from the Salt Plain in Wood Buffalo Park, Alta., and certainly to be expected north of Alberta—Mackenzie border. New to the flora of Mackenzie District.

AGROPYRON TRACHYCAULUM (Link) Malte var. NOVAE-ANGLIAE (Scribn.) Fern.
MACK: very scattered in very moist clay, Salt Plain west of Ft. Smith, *4567* (det. H. A. Senn).

Apparently the first record of this variety east of the Mackenzie Mountains.

AGROPYRON TRACHYCAULUM (Link) Malte var. GLAUCUM (Pease & Moore) Malte
MACK: sand of bank along river shore west of town, Ft. Smith, *4632;* common along roadside on escarpment 3 miles west of Salt Plain approx. 30 miles west of Ft. Smith, *Loan 129;* fairly common in clumps in sandy gravel, Little Buffalo River, 32 miles west of Ft. Smith, *4764;* scattered on sand hillside, Jackfish Lake, Yellowknife, *3207;* shallow soil in hollow of rock, rather rare, Latham Island, Yellowknife, *3078;* clump on open hillside, Yellowknife River Power House, *3305* (all det. H.A. Senn).

This variety has apparently not previously been recorded from Mackenzie District, but is evidently widespread, although not common, in the southern portions.

AGROPYRON TRACHYCAULUM (Link) Malte var. UNILATERALE (Cassidy) Malte
MACK: common in clearing in jack pine—aspen woods, sandy loam, Ft. Smith, *Loan 114;* clump in disturbed ground along roadside on western edge of Salt Plain bordering escarpment, west of Ft. Smith, *4583;* clump in sandy gravel, Little Buffalo River, 32 miles west of Ft. Smith, *4754* (all det. H.A. Senn).

Recorded by Raup (1935, 1936) from Wood Buffalo Park, Alta., and certainly to be expected in the area lying just north of the Alberta—Mackenzie border. Raup (1947) also cites a specimen from Brintnell Lake in the Mackenzie Mountains.

AGROPYRON PECTINIFORME Roem. & Schult.
MACK: fairly common in clumps in pure sand, Ft. Smith, *4157;* introduced as grass around building, Yellowknife, *3088.*

At Yellowknife a patch 20 ft. square planted from seed was maintaining itself by a dwelling; it was apparently not spreading; introduced; not previously recorded for Mackenzie District.

AGROPYRON REPENS (L.) Beauv. var. REPENS
MACK: rare on sand hillside overlooking Slave River, Ft. Smith, *4607.*

Introduced; not previously recorded from Mackenzie District.

COLPODIUM FULVUM (Trin.) Griseb. (*Arctophila fulva* (Trin.) Rupr.)
MACK: in 6 inches water, Pearson Point [east end of] Great Slave Lake, *Fredeen 68.*

Previously known in the Mackenzie basin from only one collection from the south shore of Great Slave Lake, Black Bay, E. of mouth of Rocher R. (Raup 1936).

ELYMUS CANADENSIS L.
MACK: exposed sandy ridge, West Channel, Hay River, *Lewis 949.*

This is apparently the only collection from Mackenzie District made since Richardson's collection on Great Slave Lake.

ELYMUS MACOUNII Vasey
MACK: very rare, edge of scrub birch—willow area, Salt Plain west of Ft. Smith, *4580.*

This hybrid between *Agropyron trachycaulum* and *Hordeum jubatum* might be found anywhere the parents are found together. Both these species occur far to the northward in Mackenzie District, but the hybrid has apparently not previously been collected north of Wood Buffalo Park, Alta. (Raup 1936).

SPHENOPHOLIS INTERMEDIA (Rydb.) Rydb. (? S. *pallens* sensu Raup)
ALTA: disturbed ground by roadside, rare, Ft. Fitzgerald, *4436;* MACK: exposed well-drained waste land, Alexandra Falls on Hay River, *Lewis 911.*

Previously known as far north as central Wood Buffalo Park, Alta.; new to the flora of Mackenzie District.

AVENA FATUA L. var. PILOSISSIMA S. F. Gray
MACK: exposed sandy slope of roadside, solitary, Lower Hay River, *Lewis 1104.*

Introduced; not previously recorded for Mackenzie District.

CALAMAGROSTIS LAPPONICA (Wahl.) Hartm.
MACK: shallow humus over rock, rare, Prelude Lake, *3143;* in dry moss in hollow of rock, Joliffe Island, Yellowknife, *3109.*

Apparently not previously known from the area around Great Slave Lake, Raup (1947) includes in discussion of the varieties of this species described from North America.

CALAMAGROSTIS NEGLECTA (Ehrh.) G. M. & S.
MACK: Fairly common in dry sand, Yellowknife, *3059;* very scattered in moist ground by bay, Yellowknife, *3057;* common, rooted in wet moss on sedge—grass flats by lower town, Yellowknife, *3339.*

Apparently not previously known from the area around Great Slave Lake.

ARCTAGROSTIS ARUNDINACEA (Trin.) Beal
MACK: exposed sandy slope, common, 24 miles south of Lower Hay River, *Lewis 944;*

exposed dry sandy slope of roadside, Lower Hay River, *Lewis 599;* edge of woods, common, Long Island, Great Slave Lake, *Lewis 751;* exposed sand shore, common, Brabant Island, Great Slave Lake, *Lewis 1036.*

Apparently not previously collected in the region around Great Slave Lake, but certainly to be expected in the western portions.

PHLEUM PRATENSE L.
ALTA: sand by buildings, rare, Ft. Fitzgerald, *4101;* MACK: small clumps in disturbed sand by airstrip, rare, Ft. Smith, *4359;* scattered on sand hillside, Ft. Smith, *4529;* occasional along any sandy roadside, Alexandra Falls on Hay River, *Lewis 556;* moist peat ridge, occasional, Lower Hay River, *Lewis 747;* common along exposed dry roadside, Lower Hay River, *Lewis 877;* sandy gravel, rare, airstrip, Yellowknife, *2707;* in gravel, rare, Yellowknife, *2960;* scattered in sandy gravel along roadside north of Kam Lake, Yellowknife, *2967.*

Previously known from Wood Buffalo Park, Alta.; introduced; not previously recorded for Mackenzie District.

MUHLENBERGIA SQUARROSA (Trin.) Rydb. (*M. richardsonis* (Trin.) Rydb.)
MACK: bordering a scrub birch–willow area, rare, Salt Plain west of Ft. Smith, *4581.*

Previously known from Wood Buffalo Park, Alta. (Raup 1935) and along the Bear River (Porsild 1943). This is the second record for Mackenzie District.

ORYZOPSIS PUNGENS (Torr.) Hitchc.
MACK: very scattered in clumps in open sand west of town, Ft. Smith, *3669* and *4039;* rare in sand by roadside in cut-over scrub area, Bell Rock, eight miles west of Ft. Smith, *3734.*

Previously known from central Wood Buffalo Park, Alta.; new to the flora of Mackenzie District.

STIPA SPARTEA Trin. var. CURTISETA Hitchc.
ALTA: sandy soil, top of bank overlooking Athabaska River, Ft. McMurray, *7278.*

This is apparently the northern limit of this variety in eastern Alberta. In northwestern Alberta, E.H. Moss has collected it at Smoky River east of Grande Prairie, slope of Saddle River Valley at Wanham, Meickle River north of Manning, Keg River, near Meander River and at Paddle Creek west of Fort Vermillion (specimens in DAO). It is not recorded by Raup (1934) or Groh (1949).

HIEROCHLOË ODORATA (L.) Wahl.
MACK: common in sod, outlet of Prosperous Lake, Yellowknife River, *2188;* low wet soil on shore of lake, rare, Indin Lake, *3410.*

This species has apparently not previously been noted from east of the Paleozoic boundary in Mackenzie District.

CYPERACEAE

ERIOPHORUM GRACILE W.D.J. Koch
ALTA: floating bog around small lake in muskeg 12 miles north of Ft. Fitzgerald, *4263;* fairly common in floating bog around small lake 2 miles southwest of Ft. Smith N.W.T. in Alberta, *4028.*

Apparently not previously known in Alberta north of the Edmonton–Lesser Slave Lake district (Raup 1934, Turner 1949); its presence just south of the Alberta–Mackenzie border would indicate that it may quite possibly be found in southern Mackenzie District.

SCIRPUS PALUDOSUS A. Nels.
MACK: in depression bordering saline plain, Salt Plain west of Ft. Smith, *Loan 313.*

Previously known from the Salt Plains in Wood Buffalo Park, Alberta, and certainly expected to extend north of the Alberta–Mackenzie border. New to the flora of Mackenzie District.

ELEOCHARIS PAUCIFLORA (Lightf.) Link var. FERNALDII Svenson
MACK: predominant in moist moss along shoreline, Long Island, Great Slave Lake, *Lewis 768;* forming several large patches in wet sand on beach, shore of Sand Lake, Yellowknife, *3136.*

Previously known in Mackenzie District from two regions: east end of Great Slave Lake (Raup 1936) and Great Bear Lake (Porsild 1943).

CAREX CAPITATA L.
ALTA: rare, under aspen in sand along roadside 4 miles north of Ft. Fitzgerald, *4725;* fairly common in deep wet moss at edge of spruce forest 7 miles north of Ft. Fitzgerald, *3860;* scattered in clumps in deep moss of burnt over black spruce muskeg 12 miles north of Ft. Fitzgerald, *4533;* MACK: occasional in peat at edge of marsh, Brabant Island, Great Slave Lake, *Lewis 1044;* occasional in wet moss along sheltered shoreline, Long Island, Great Slave Lake, *Lewis 780;* drier ground near pot holes, Gros Cap Island, Great Slave Lake, *Reeder 1791;* open peaty area, common, Yellowknife, *2402;* moist shal-

low soil along shoreline, Indin Lake, *3379, 3459.*

This species is found in the wooded country from Newfoundland to Alaska, but is apparently little known in our area. Raup (1935, 1936, 1947) records it from Methye Portage and Wood Buffalo Park, Alta. and the Canol Road and east end of Great Slave Lake in Mackenzie District.

CAREX MARITIMA Gunner (C. *incurva* Lightf.)
MACK : bog, Pearson Point, Great Slave Lake, *Fredeen 9.*

Previously known from the arctic coast and Great Bear Lake (Raup 1947); this collection represents an extension of range of some 350 miles to the southeast.

CAREX CHORDORRHIZA Ehrh.
ALTA : fairly common in floating bog around small lake in muskeg area 12 miles north of Ft. Fitzgerald, *4546;* scattered in floating bog around small lake, 1½ miles southwest of Ft. Smith N.W.T. in Alberta, *4238.*

Previously unknown in the region between Lake Athabaska and Great Bear Lake (Raup 1947).

CAREX DISPERMA Dewey
MACK : wet open peat area near Con Mine, in mats, common here, Yellowknife, *2405;* wet peat area, rare, Snare River Power Station, *2628.*

Previously recorded for Mackenzie District from Clewi R. (Raup 1935), Simpson (Raup 1947), Aklavik and Great Bear Lake (Porsild 1943).

CAREX BONANZENSIS Britt.
MACK : along roadside in ditch, Lower Hay River, *Lewis 408.*

This is a Yukon-Siberian species that has previously only been recorded twice from Mackenzie District : Simpson (Raup 1947) and Aklavik (Porsild 1943).

CAREX AENEA Fern.
ALTA : very shallow soil over igneous rock, rare, Ft. Fitzgerald, *4433;* MACK: disturbed humus pushed up beside road, rare, Bell Rock 8 miles west of Ft. Smith, *4396;* common in sand in clumps, airstrip, Yellowknife, *2689;* gravel roadside by cemetery near airport, common, Yellowknife, *3274* (det. Hermann); wet sand, shore of Sand Lake, Yellowknife, *3122;* disturbed ground around buildings, rare, Indin Lake, *3411.*

Raup (1947) tentatively referred an immature specimen collected at Simpson to this species, but otherwise it was previously unknown north of Lake Athabaska (Raup 1936).

CAREX SYCHNOCEPHALA Carey
MACK : exposed sandy slope of roadside, rare, Lower Hay River, *Lewis 967;* alluvial soil at mouth of Baker Creek, rare, Yellowknife, *3494.*

Previously known in our area from two collections; central Wood Buffalo Park, Alberta and Lake Athabaska; new to the flora of Mackenzie District.

CAREX SUPINA Willd. ssp. SPANIOCARPA (Steud.) Hultén
MACK : dry hillside, Gros Cap Island, Great Slave Lake, *Reeder 1777;* sand and gravel hillside, common, Jackfish Lake, Yellowknife, *2670;* very shallow soil in rock crevices, scattered locally, near Negus Mine, Yellowknife, *2418;* shallow soil on rocky hillside, very common, Eldorado Mine, Port Radium, *2780;* in small clumps on sandy island, southwest of head of Bathurst Inlet (66°04'N, 108°28'W), *Woodruff 74.*

Previously known in our area from a Richardson specimen from Great Bear Lake, the east end of Great Slave Lake and Lake Athabaska (Raup 1936, 1947).

CAREX PECKII Howe
ALTA : in poplar woods, Lac la Biche, *6930, 6964;* sandy soil in open *Populus tremuloides–Abies balsamifera* woods, Big Island, Lac la Biche, *7059;* open white spruce woods, Lac la Biche Mission, *7024.*

The northernmost records for this species in Alberta are the present collections and one from Lesser Slave Lake District (Raup 1934). There is however, a record from Mooshide Mountain in Central Yukon, some 1000 miles to the northwest, which would indicate that this species should be searched for in the intervening territory.

CAREX DEFLEXA Hornem.
MACK : sand and gravel along roadside just west of new townsite, Yellowknife, *2522;* in pure sand near swimming beach at Sand Lake, Yellowknife, *3142;* in crevices of rock, rare, Dome Lake, *3185;* very shallow soil in hollow on rocky hillside, rare, Snare River Power Station, *2623;* in clumps in humus-rich disturbed ground around buildings, Indin Lake, *3440.*

Porsild (1943) reported this species as new to the Northwest Territories on the basis of his collections from Great Bear Lake. Raup

(1947) later collected it at Brintnell Lake and Red Mountain in the Mackenzie Mountains. To the south it is known from Lake Athabaska. The present collections help fill in our knowledge of the distribution of this species in Mackenzie District.

CAREX ROSSII Boott
MACK: in humus in hollows and crevices of rocky hillsides and in sand and gravel, Yellowknife, *2428, 2530, 2667, 2686, 3275;* in pure sand, rare, Snare River Power Station, *2634.*

The known range of this species is extended some 300 miles northwest from Ft. Smith.

CAREX SPRENGELII Dewey
ALTA: rare in waste ground along roadside, Ft. McMurray, *7248.*

Recorded by Turner (1949) from Ft. Saskatchewan (specimens in DAO); this collection represents a northward extension of the known range in Alberta of some 200 miles.

CAREX LASIOCARPA Ehrh. var. AMERICANA Fern.
ALTA: occasional to common in floating bog around small lake 1½ miles southwest of Ft. Smith N.W.T. in Alberta, *4026, 4244.*

This is an extension of the known range into northern Alberta of some 100 miles from the south shore of Lake Athabaska in Saskatchewan. Turner (1949) records it from Ft. Saskatchewan near Edmonton, Alberta. See Raup (1936, 1947) for a discussion of the possible occurrence of this species and *C. lanuginosa* in Mackenzie District.

CAREX RAYMONDII Calder
ALTA: black sandy soil in *Populus -- Salix -- Picea glauca* woods, rare, 1 mile southwest of Ft. Smith N.W.T. in Alberta, *4498;* MACK: clumps in sod in sand by roadside, Seven Mile Lake, 27 miles west of Ft. Smith, *4640;* moist crevices in calcareous rocks, common, Alexandra Falls on Hay River, *Lewis 643.*

The specimens listed above are paratypes of the species described by Calder (Rhodora 54:246-250. 1952). Specimens cited under *C. atratiformis* by Raup (1935) from Wood Buffalo Park probably belong here.

CAREX BUXBAUMII Wahl.
MACK: low wet soil on shore of lake, localized, Indin Lake, *3409.*

Not previously recorded from the area between Lake Athabaska and Great Bear Lake; the second record for Mackenzie District.

CAREX MEDIA R. Br. (*C. vahlii* Schkuhr var. *inferalpina* (Wahl.) Fern.)
MACK: bog, Pearson Point, Great Slave Lake, *Fredeen 47;* damp soil, Gros Cap Island, Great Slave Lake, *Reeder 1792;* rich black soil near north end of Kam Lake, fairly common, Yellowknife, *2527;* rich black peaty muck north of town, rare, Yellowknife, *2552;* humus over rock, rare, Yellowknife River Power House, *3301.*

Apparently not previously recorded from the region around Great Slave Lake.

CAREX ROSTRATA Stokes
MACK: several large stands in 10 inches water along lakeshore, Indin Lake, *3430;* shallow marsh in 4 inches water, 36 miles south of Aklavik, *Stevens s.n.* Aug. 7, 1947.

Raup (1947) cites a Richardson specimen collected on the Mackenzie River but states that the northern limit is yet unknown. Hooker (1829-40) gives the distribution of this species *(C. ampullacea)* as "Cumberland House, Bear Lake..." The specimens recorded here are apparently the only collections north of Great Slave Lake with exact locality data.

ARACEAE

ACORUS CALAMAS L.
ALTA: muck along river's edge, Beaver River 2 miles south of Briarville P.O., *7154;* rare in wet meadow, Lac la Biche, *6864.*

Not recorded by Raup (1936) but reported by Turner (1949) at Lily Lake, 23 miles northwest of Fort Saskatchewan, some 100 miles southwest of Lac la Biche.

LEMNACEAE

LEMNA TRISULCA L.
MACK: rare, suspended in water at edge of lagoon, Lower Hay River, *Lewis 580;* among broken reeds at mouth of small creek on west shore of Kam Lake, Yellowknife, *3546.*

Previously known from central Wood Buffalo Park, Alta. (Raup 1935) and from Mackenzie River Delta (Porsild 1943) and certainly to be expected in the intervening area.

JUNCACEAE

JUNCUS BUFONIUS L.
MACK: wet sand bank of Slave River, rare, Ft. Smith, *4532;* moist peat soil, partially exposed, common, Lower Hay River, *Lewis 1103;* scattered in moist clay soil, Yellowknife, *3338;* common, rooted in muck of flats by bay, Yellowknife, *3549;* in wet sand of broad road-

side ditch on road to airstrip, local, Yellowknife, *3262*.

Not previously recorded from the area between central Wood Buffalo Park, Alberta and Ft. Simpson (Raup 1935, 1947), but recorded by Hooker (1829-40) as occurring "throughout Canada to Bear Lake."

JUNCUS FILIFORMIS L.
MACK: moist crevice of calcareous rock, Alexandra Falls on Hay River, *Lewis 374;* among pebbles at water's edge, rather rare, Yellowknife River Power House, *3291*.

Recorded by Hooker (1829-40) as "Saskatchewan to Bear Lake..." but Raup (1947) reported that he had seen no specimens from north of Wood Buffalo Park [Alberta]; these are the first substantiated records from Mackenzie District.

LILIACEAE

ZYGADENUS ELEGANS Pursh
MACK: along Brock River approximately 8 miles directly east of its mouth, *Ross Mackay s.n.* July 25, 1951; on glacial till along the Hornaday River approximately 26 miles directly southeast of its mouth, *Ross Mackay s.n.* July 21, 1951.

According to the map in Raup (1947) these collections extend the known range some 150 miles eastward along the arctic coast.

LILIUM PHILADELPHICUM L. var. ANDINUM (Nutt.) Ker.
ALTA: a single plant, *7281*, with perianth segments yellow, 20–30 small reddish-orange dots near the base of each segment and yellowish stamens, was found growing with the typical form in *Populus–Picea* woods at Ft. McMurray. This would appear to be approaching what Raup (1934) has described as forma *immaculatum*.

SMILACINA TRIFOLIA (L.) Desv.
MACK: Moist peat area in front of hospital, very rare, Yellowknife, *2603;* in wet moss, rare, Snare River Power Station, *2629*.

This species is found in the Mackenzie River basin at least as far north as the Simpson region, but it has apparently not previously been recorded from east of the Paleozoic boundary in Mackenzie District.

ORCHIDACEAE

HABENARIA VIRIDIS (L.) R. Br. var. BRACTEATA (Muhl.) Gray
MACK: fairly common in shade of *Equisetum arvense* in scrub spruce woods at base of sand escarpment overlooking Slave R., Ft. Smith, *3928, 4073;* sand in *Populus–Salix* bush, very rare, airport, Ft. Smith, *4347;* sand at edge of poplar–spruce woods, rare, Seven Mile Lake, 27 miles west of Ft. Smith, *4643*.

To the south, this species has been collected in central Wood Buffalo Park, Alberta (Raup 1935); in Mackenzie District, Raup (1947) records it from two localities, one on the Liard between Nahanni Butte and Simpson and the other on the Mackenzie at Nahanni Mt.

SPIRANTHES ROMANZOFFIANA Cham.
MACK: very rare in moist moss of muskeg, Indin Lake, *3455*.

This is perhaps from the northeastern limit in Mackenzie District.

CORALLORHIZA MACULATA Raf.
ALTA: rare on steep slope in poplar woods 2 miles east of Lac la Biche, *6948*.

This species was not recorded for northern Alberta either by Raup (1934, 1936) or Turner (1949), although it was certainly to be expected for Raup (1934) records a specimen from almost the same latitude at Rocky Mountain Canyon near Hudson Hope, B.C.

SALICACEAE

SALIX SERISSIMA Fern.
MACK: shrub 4–5 ft. in open scrub area south of town, Ft. Smith, *3814*.

This is a northwestward extension of range from the north shore of Lake Athabaska in Saskatchewan; new to the flora of Mackenzie District.

This species can be separated from *S. lasiandra*, which also occurs in the area, by its shorter aments and white-pubescent bracts. *S. serissima* was collected in flower at Ft. Smith on June 15; *S. lasiandra* was collected in flower along the Slave River at Ft. Fitzgerald a few miles to the south on June 6, and in fruit at the same location on June 18.

SALIX ARCTOPHILA Cockerell
MACK: Pearson Point, Great Slave Lake, *Fredeen 118;* prostrate shrub among rocks at mouth of small creek, Indin Lake, *3467*.

SALIX MACCALLIANA Rowlee
MACK: shrub to 6 ft., very scattered in sand in open pastured scrub area just south of townsite, Ft. Smith, *3816, 3975*.

Previously known from the Salt Plains in Wood Buffalo Park, Alberta, and certainly expected to occur north of the Alberta–Mackenzie border. New to the flora of Mackenzie District.

SALIX LUTEA Nutt.
MACK: shrub 2–3 m high along river on stone–clay slope, West Channel, Hay River, *228, 229.*

Raup (1947) records a collection of this species from Lower Slave River; the present collections are apparently the first from the shores of Great Slave Lake and the second from Mackenzie District.

SALIX PSEUDOMONTICOLA Ball
MACK: shrub to 5 ft. scattered in sand in open scrub area south of town, Ft. Smith, *3818.*

Raup (1935) records two collections of this species from Wood Buffalo Park, Alberta, to the southwest. Its presence in southern Mackenzie District was certainly to be expected. New to the flora of Mackenzie District.

SALIX BARRATTIANA Hook. var. ANGUSTIFOLIA Anders.
MACK: shrub 8 ft. in hollow between outcrops on west side of Kam Lake, Yellowknife, *2204* (det. Ball).

S. barrattiana is a cordilleran species. Raup (1947) and Porsild (1945) have recorded *S. barrattiana* and its var. *marcescens* from the Mackenzie Mountains. This record of var. *angustifolia* from Yellowknife is apparently the easternmost for any of the forms of *S. barrattiana.* It is new to the flora of Mackenzie District.

Var. *angustifolia* differs from the typical variety, among other characters, in having the leaves narrower and acute rather than rounded to the base.

SALIX PEDICELLARIS Pursh var. HYPOGLAUCA Fern.
MACK: 6 ft. shrub, rare in moist peaty area by shore of Sand Lake, Yellowknife, *2604.*

Apparently not previously collected east of the Paleozoic boundary in Mackenzie District or in the area between Lake Athabaska and the Lower Mackenzie River.

SANTALACEAE

GEOCAULON LIVIDUM (Richards.) Fern.
MACK: common in peaty soil on wooded hillsides, Snare River Power station, *2609;* shallow humus-rich soil on rock hillsides, fairly common, Indin Lake, *3394;* scattered in moss, Beaverlodge Lake, *2731.*

Apparently not previously collected in the Pre-Cambrian north of Great Slave Lake, although it is recorded by Hooker (1829-40) as occurring "to lat. 69° on the Mackenzie River." These specimens are probably from near the northeastern limit in Mackenzie District.

POLYGONACEAE

RUMEX ?PALLIDUS Bigel.
MACK: clay bank of river, rare, Salt River [west of Ft. Smith], *4595;* roadside, Salt River, *Loan 142.*

These specimens appear to be somewhat intermediate between *R. sibiricus* and *R. pallidus.* The mature valves in *Loan 142* measure 3.3–4.5–(5.0) mm in length, usually extending to a pointed tip beyond the 2.2–3.0 mm long callus. *R. sibiricus* is described as having valves 3–4 mm long, not much longer than the callus. Rechinger (1937) in his monograph of the genus *Rumex* included inland Alaska and Yukon specimens with the eastern North American maritime *R. pallidus.* Hultén (1941-1952) in Flora of Alaska and Yukon referred these specimens to his *R. sibiricus.* He also tentatively referred an immature Raup collection from Wood Buffalo Park to this entity. Our specimens have the flowers and fruits closely approximate and not widely separated in whorls as in the Brenner [type ?] specimen depicted by Rechinger. The specimens at hand may possibly represent an entity as yet undescribed.

POLYGONUM ACHOREUM Blake
ALTA: common along roadsides, Lac la Biche, *6951;* common along roadsides, Ft. McMurray, *7244;* MACK: fairly common in waste ground along roadsides and around buildings, Ft. Smith, *4773;* exposed slope of roadside, Lower Hay River, *Lewis 1112;* in sandy gravel, rare, airstrip, Yellowknife, *3230.*

Turner (1949) has numerous collections of this species from the Fort Saskatchewan area and Groh (1949) has recorded a collection from Keg River. Raup (1934, 1936, 1947), however, does not record it from the area to the north, which would indicate that it has been introduced into that country only recently. New to the flora of Mackenzie District.

POLYGONUM AMPHIBIUM L. var. STIPULACEUM (Coleman) Fern. forma FLUITANS (Eat.) Fern. (*Polygonum hartwrightii Gray*)
MACK: forming large patch 15 ft. in diameter in 15 inches water, Indin Lake, *3408.*

This is apparently the northernmost record for this species and the only collection from east of the Paleozoic boundary in Mackenzie District. Previously known from Great Slave Lake and Simpson, and to be expected some distance northward down the Mackenzie River valley.

POLYGONUM LAPATHIFOLIUM L. including var. SALICIFOLIUM Sibth, (*Polygonum persicaria* L. var. *minus* Hook.)
MACK: moist ditch by roadside, rare, Lower Hay River, *Lewis 880;* exposed slope of roadside, occasional, Lower Hay River, *Lewis 1114, 1115;* sandy soil by roadside, rare, Yellowknife, *3515*; prostrate in moist peat of garden area, Yellowknife, *3330;* in wet moss among sedges by bay, rare, Yellowknife, *3512;* moist soil by lake shore, decumbent, Indin Lake, *3399.*

Polygonum persicaria var. *minus* is recorded by Hooker (1829-40) as occurring to Great Bear Lake, but apparently the only specimen collected previously from Mackenzie District is one by Raup from near Simpson. It may be expected northward along the Mackenzie River valley.

POLYGONUM SCABRUM Moench.
MACK: moist black humus over sand, rare, by garden area at north end of Kam Lake, Yellowknife, *3544.*

Introduced; new to the flora of Mackenzie District. Not previously known north of the Edmonton district (Turner 1949).

POLYGONUM CONVOLVULUS L.
ALTA: very shallow soil over igneous rock, scattered, Ft. Fitzgerald, *4430; MACK:* very scattered in sand, waste area by Hudson Bay Co., Ft. Smith, *4774;* scattered in moist shallow peat over sand, north end of Kam Lake by garden area, Yellowknife, *3530.*

Introduced; new to Mackenzie District. To the south, previously known from the upper Slave River Lowland (Raup 1936).

CHENOPODIACEAE

CHENOPODIUM GIGANTOSPERMUM Aellen
ALTA: shallow soil over igneous rock at quarry, rare, Ft. Fitzgerald, *4111.*

Our specimen appears to belong to this entity although it is of lush growth and quite immature. *C. gigantospermum* is known to the south around Edmonton and in the Peace River district.

CHENOPODIUM BERLANDIERI Moq. var. ZSCHACKEI (Murr.) Murr.
MACK: common in moist shallow peat over sand, north end of Kam Lake, Yellowknife, *3529.*

Some of the specimens recorded by Raup (1936, 1947) under *C. album* probably belong here, as may also part of the basis of the record in Hooker (1829-40) "From Lake Huron ... to Bear Lake."

MONOLEPIS NUTTALLIANA (R. & S.) Greene
ALTA: railway embankment, Lac la Biche, *6912;* a single lush plant 2 ft. in diameter in disturbed ground by railway yards, Lac la Biche, *7107;* fairly common in sod of pasture in sand, Halfway House 7 miles north of Ft. Fitzgerald, *3865;* MACK: in rich moist humus, rare, north end of Kam Lake, Yellowknife, *3524.*

Turner (1949) has reported this species as a common weed in gardens, on roadsides, etc., in the Fort Saskatchewan area and Groh (1949) has recorded it from Keg River, Carcajou and Fort Vermillion. It is a weed that is evidently spreading northward. New to the flora of Mackenzie District.

SPINACIA OLERACEA L.
ALTA: rare, along roadside in town, Lac la Biche, *6793;* MACK: in sand, waste ground along fence line, very rare, Ft. Smith, *4142.*

Apparently a garden escape; this species appears not previously to have been recorded as growing outside cultivation in Canada.

ATRIPLEX PATULA L. var. HASTATA (L.) Gray
MACK: exposed saline plain, common, Salt Plains west of Ft. Smith, *Loan 304.*

Previously known on the Salt Plains in Wood Buffalo Park, Alberta and certainly to be expected in similar habitats north of the Alberta–Mackenzie border. New to the flora of Mackenzie District.

SUAEDA DEPRESSA (Pursh) S. Wats.
MACK: exposed saline plain, poor drainage, Salt Plain west of Ft. Smith, *Loan 306;* bordering slough in saline plain, common, Salt Plain west of Ft. Smith, *Loan 316.*

Both Nos. *306* and *316* were collected on the same day, Aug. 21, 1950, the specimens of No. *306* measured up to 14 inches in height and were dark green in color, those of No. *316* taken from the immediate vicinity of the saline depressions measured 2 to 4 inches in height and were reddish green. Inundation of the ground occupied by the latter plants in the early part of the season probably accounts for these differences at least to some extent; increased salinity might also have some effect.

Suaeda depressa has been recorded by Raup (1935, 1936) from the Salt Plains south of the Alberta–Mackenzie border and was certainly to be expected in similar habitats north of the border. New to the flora of Mackenzie District.

CARYOPHYLLACEAE

STELLARIA MEDIA (L.) Cyrill.
MACK: prostrate on moist peat of garden, Yellowknife, *3328;* a week in garden, shallow peat over sand, scattered, Yellowknife, *3521.*

Introduced; with the exception of a collection from Ft. Simpson, unknown north of Chipewyan; the second record for Mackenzie District.

STELLARIA CRASSIFOLIA Ehrh.
MACK: in wet moss, Tochatwi Bay, Great Slave Lake, *Fredeen 10;* in dry gravel by roadside, rare, west side of Kam Lake, Yellowknife, *2992;* small clump 1 ft. in diameter in moss in shallow moist soil at mouth of creek, west side of Kam Lake, Yellowknife, *3985.*

Apparently not previously recorded from the area around Great Slave Lake.

STELLARIA ATRATA (J. W. Moore) Boivin var. ATRATA (*S. longifolia* sensu Raup pro parte)
MACK: Lower Hay River, *Lewis 962;* Long Island, Great Slave Lake, *Lewis 787.*

Recorded from Mackenzie District by Boivin (Sv. Bot. Tidskr. 47(1):43-46. 1953) on the basis of these collections.

STELLARIA ATRATA (J. W. Moore) Boivin var. ECILIATA Boivin (*S. longifolia* sensu Raup pro parte)
ALTA: Ft. Fitzgerald, *4116;* 9 miles south of Ft. Smith, N.W.T., *Loan 87;* 13 miles north of Pine Lake, Wood Buffalo Park, *4278;*
MACK: Ft. Smith, *4217;* Bell Rock, 8 miles west of Ft. Smith, *4383;* Wynn's Mill, Long Island, Slave River, *3988;* Lower Hay River, *Lewis 331, 536, 588;* Brabant Island, Great Slave Lake, *Lewis 1018;* Yellowknife, *2509, 2550, 2597, 2676.*

These specimens were cited by Boivin (loc. cit.) as paratypes of his new variety.

CERASTIUM ARVENSE L.
MACK: in small mats in sand in sod around farm buildings, Ft. Smith, *4063, 3979;* fairly common in sod, Salt Plain west of Ft. Smith, *3790, 3687.*

Previously known from Wood Buffalo Park, Alberta (Raup 1935) and from Mackenzie River Delta and Great Bear Lake (Porsild 1943) and certainly to be expected in the intervening area.

CERASTIUM VULGATUM L. var. HIRSUTUM Fries
ALTA: common on moist wood shavings with *Equisetum arvense, Carex* sp. and grasses, Lac la Biche, *6829.*

This is an introduced plant that is now of quite common occurrence in eastern Canada. It has not however, reached any great abundance in the prairie provinces. Turner (1949) records several collections from Fort Saskatchewan and Pigeon Lake, but it is not recorded from Alberta by Raup (1934, 1936, 1947) or Groh (1949), although Raup (1934) does record a Dawson collection from north of Finlayson Lake, lat. 59° in northern British Columbia. The collection from Lac la Biche is apparently from the northernmost known locality in Alberta.

ARENARIA CAPILLARIS Poir.
MACK: sandy dry land, Sawmill Bay, Great Bear Lake, *Corcoran 2.*

This is an extension of some 600 miles eastward from a station in Yukon; new to the flora of Mackenzie District.

SPERGULA ARVENSIS L.
MACK: sandy gravel, airstrip, Yellowknife, *3228.*

Introduced; new to the flora of Mackenzie District; the nearest records for this species are apparently in the Edmonton district (Turner 1949), some 600 miles to the south.

SILENE MENZIESII Hook.
MACK: in sand in shade of *Populus,* rare, Ft. Smith, *4067.*

This species is apparently very rare in our area. It was first collected here by Richardson at "Portage d'embarras, Slave River" [one of the portages between Ft. Fitzgerald and Ft. Smith] and then not collected again until found at Simpson by Raup in 1939. The Richardson locality is reestablished with our collection.

NYMPHAEACEAE

NYMPHAEA TETRAGONA Georgi (*N. tetragona* ssp. *leibergii* (Morong) A.E. Porsild); Porsild, (Can. Field Nat. 53:48-50, 1939); Raymond, (Seventh Pac. Sc. Cong. 5:1-10. 1953)
ALTA: rooted in ooze of small lake 1½ miles southwest of Ft. Smith N.W.T. in Alberta, *4231, 4500.*

New to the flora of Alberta. The previously known distribution of this rare species has been reviewed by both Porsild (loc. cit.) and Raymond (loc. cit.). An additional locality unknown to them is in southeastern Manitoba.
MAN: in river, Rennie, *Bill and Nina Elder s.n.* Aug. 6, 1952. This is the second record for Manitoba.

RANUNCULACEAE

CALTHA NATANS Pallas
ALTA : floating in small slough 4 miles north of Rich Lake P.O., *7180;* MACK: water along shore, Gros Cap Island, Great Slave Lake, *Reeder 1799;* forming large patch 15 ft. in diameter, rooted in muck in very shallow water of ditch, Yellowknife, *3486;* rooted in shallow muck over gravel, leaves formerly floating on water, small stream on west side of Kam Lake, Yellowknife, *2980;* Great Slave Lake area, east of mouth of Taltson R., *Harper sn.* 1914 (CAN).

Hooker (1829-40) records this species as "Creeping on the surface of deep sphagnous bogs, in the woody central districts from Canada to lat. 60°; rare. *Dr. Richardson, Drummond.*" The habitat given by Hooker seems to be incorrect. Porsild (Can. Geog. J. 42 (3):137. 1951) lists *C. natans* as a component of the strand communities east of the mouth of the Mackenzie River. There are, however, no specimens of this species in the Herbarium of the National Museum of Canada from north of Great Slave Lake. There are ample collections of *C. palustris* var. *arctica* from this region and the record of *C. natans* from there is probably an error for that entity. The specimens cited here are apparently the first records for Mackenzie District.

ANEMONE MULTIFIDA Poir.
Boivin (Can. Field Nat. 65:1-3. 1951) has distinguished a number of varieties and forms of this species based primarily on tepal color. The following may be recorded from our area:

ANEMONE MULTIFIDA var. HUDSONIANA DC. forma HUDSONIANA
MACK: West Channel Hay River, Yellowknife, Indin Lake.

Forma SANGUINEA (Pursh) Fern.
ALTA: 4 miles north of Ft. Fitzgerald; MACK: Ft. Smith, West Channel Hay River, Moraine Point Great Slave Lake, Yellowknife, 2 miles up Yellowknife River, Gordon Lake, Port Radium on Great Bear Lake.

ANEMONE MULTIFIDA var. SAXICOLA Boivin
MACK: Moraine Point Great Slave Lake, Yellowknife.

Not previously recorded for Makenzie District.

ANEMONE MULTIFIDA var. SANSONII Boivin forma SANSONII
MACK : Ft. Smith, Alexandra Falls on Hay River.

Not previously recorded for Mackenzie District.

Forma GALACTIFLORA Boivin
MACK : Ft. Smith.

Not previously recorded for Mackenzie District.

ANEMONE RICHARDSONII Hook.
MACK : shaded moist localities, rapids on north shore of Christie Bay, Great Slave Lake, *Fredeen 20.*

Apparently not previously recorded from the area around Great Slave Lake.

RANUNCULUS CIRCINATUS Sibth. var. SUBRIGIDUS (Drew) Benson
MACK : common in 2-4 ft. of quiet water, rooted in muck, Salt River, *4185;* in 2-3 inches water rooted in muck, sedge grass flats by old townsite, Yellowknife, *2586;* fairly common, rooted in ooze, small lake by old townsite, Yellowknife, *2673;* rare in 3 ft. water, rooted in muck, bay on north side of town Yellowknife, *3498.*

The only other record of this entity from Mackenzie District is a collection made by Porsild from Mackenzie River Delta.

RANUNCULUS GMELINII DC. var GMELINII
MACK : prostrate on wet mud bank of river, rare, Little Buffalo River, *Lewis 329;* prostrate herb on surface of water in marsh, occasional, Brabant Island, Great Slave Lake, *Lewis 1096*; forming mat 4 ft. in diameter on rich black peaty muck, Yellowknife, *2553;* floating in shallow water rooted in muck and prostrate on very wet muck, road into Kam Lake, Yellowknife, *2259, 2310;* in very shallow water along outlet of Jackfish Lake, local, Yellowknife, *3211.*

Not previously recorded from the area between Peace River Landing, Alberta and Great Bear Lake.

RANUNCULUS RHOMBOIDEUS Goldie
MACK : rare on Salt Plain west of Ft. Smith, *3689.*

Previously known from the prairies in central Wood Buffalo Park, Alberta, and certainly to be expected in similar habitats north of the Alberta — Mackenzie border; new to the flora of Mackenzie District.

RANUNCULUS ABORTIVUS L.
MACK : moist sand of roadside ditch, rare, Seven Mile Lake, 27 miles west of Ft. Smith, *4646.*

This is a northward extension of range from southern Wood Buffalo Park, Alberta; new to the flora of Mackenzie District.

RANUNCULUS UNCINATUS D. Don var. UNCINATUS
ALTA: rare in moist *Populus — Salix* burnt over area 1 mile southwest of Ft. Smith, N.W.T. in Alberta, *4510;* MACK: scattered along lakeshore in moist silt, Seven Mile Lake, 27 miles west of Ft. Smith, *4679.*

These collections represent a northward extension of the known range from the lower Peace River near the western boundary of Wood Buffalo Park. New to the flora of Mackenzie District.

RANUNCULUS PENSYLVANICUS L.
ALTA: very scattered in moist sandy soil around small lake on Pine Lake Road 13 miles north of Pine Lake, Wood Buffalo Park, *4288.*

This is an northwestward extension of range of some 75 miles from stations cited by Raup at the west end of Lake Athabaska. It could quite conceivably be found at least as far north as the southern limits of Mackenzie District for Hooker (1829-40) records it as "equally diffused" with *R. hispidus (R. macounii).*

RANUNCULUS CYMBALARIA Pursh. var. CYMBALARIA
MACK: low moist ground along lake shore, Resolution, *Fredeen 105;* moist moss at edge of river, occasional, Alexandra Falls on Hay River, *Lewis 639;* moist peat at edge of pool, Old Settlement, Hay River, *Lewis 676.*

Hooker (1829-40) recorded this species as "... from Canada to near the Arctic Sea, lat. 68°...", but Raup (1947) stated that he had seen no authentic material from north of the Little Buffalo River. The specimens cited here authenticate the northward range to the south shore of Great Slave Lake. It may yet be found to the north, at least along the upper Mackenzie River.

THALICTRUM TURNERI Boivin
MACK: moist edge of aspen — spruce forest, occasional, Alexandra Falls on Hay River, *Lewis 375;* moist shelter of *Salix* by river, common, Lower Hay River, *Lewis 727, 728* (all det. Boivin).

The immature specimens from Ft. Simpson referred tentatively by Raup (1947) to *T. occidentale,* are quite possibly *T. turneri,* since *T. occidentale,* according to Boivin, is a Rocky Mountain species. The other specimen reported by Raup, *Crickmay 47* from Liard River between Nahanni Butte and Simpson, is a paratype of *T. turneri.*

FUMARIACEAE

CORYDALIS SEMPERVIRENS (L.) Pers.
MACK: Gordon Lake, *Denton s.n.;* in rock crevices, scattered, Dome Lake, *3167;* shallow soil in crevice of rock, Snare River Power Station, *2611;* very shallow moss layer over rock, rare, Beaverlodge Lake, *2730;* scattered in disturbed ground around buildings, Indin Lake, *3342;* scattered in shallow soil on rocky hillside, Gunbarrel Inlet, Great Bear Lake, *2834.*

Hooker (1829-40) records this species as "Throughout Canada as far as lat. 64°" and Raup (1947) cites a Crickmay specimen collected along the Mackenzie River between Wrigley and Blackwater River. There do not, however, appear to be any records of collections in the Pre-Cambrian country north of the north shore of Great Slave Lake. The northernmost record is apparently Gunbarrel Inlet at 65°37'N.

CORYDALIS AUREA Willd. ssp. AUREA
MACK: sandy beach, Redcliff Island, Great Slave Lake, *Fredeen 145;* open woods, Gros Cap Is., Great Slave Lake, *Reeder 2860;* sheltered rock crevices, Yellowknife Bay, *McIntyre 1815;* in sandy gravel and disturbed ground, Yellowknife, *2081, 2157, 3267;* in sand, Snare River Power Station, *2635;* shallow soil on rocky hillside, rather rare, Indin Lake, *3423;* mucky sand, Sawmill Bay, Great Bear Lake, *Corcoran 16;* light shallow soil over rock on hillside, under tall white spruce, only one plant found, Gunbarrel Inlet, Great Bear Lake, *2849.*

Hooker (1829 40) records this species as "Throughout Canada to lat. 64° (Dr. Richardson) in the woody country." Raup (1947) records a specimen collected by Crickmay along the Mackenzie River between Wrigley and Blackwater River, but there have apparently been no previous collections recorded from east of the Paleozoic boundary. The specimen from Sawmill Bay, 65°43'N is the most northerly record.

CRUCIFERAE

SUBULARIA AQUATICA L.
MACK: very wet sedge meadow, Yellowknife, *3049;* fairly common in 4 inches water among thick mat of moss, Yellowknife, *3509;* quite common but very insignificant on wet flats just south of old townsite on Yellowknife Bay, Yellowknife, *7316;* in 4 inches water rooted in clay, Indin Lake, *3432.*

The only other collection recorded for Mackenzie District is from McTavish Arm, Great Bear Lake (Porsild 1943).

LEPIDIUM SATIVUM L.

ALTA: disturbed ground by railway yards, adjacent to garden area, Lac la Biche, *7109;* roadside recently seeded to grass Griffin Creek, south of Brownvale, Peace River District, *Groh 1013.*

Escaped from cultivation; not previously recorded for northern Alberta.

THLASPI ARVENSE L.

MACK. sand by roadside, rare, Bell Rock, 8 miles west of Ft. Smith, *4404;* dry exposed roadside, occasional, Alexandra Falls on Hay River, *Lewis 307;* exposed well-drained sandloam field, common, Old Settlement, Hay River, *Lewis 449;* in sand and in shallow layer of humus over sand near garden area, north end of Kam Lake, Yellowknife, *3525, 3545;* sandy gravel, rare, airstrip, Yellowknife, *3232.*

An introduced weed; to the south, previously known from the Government Hay Camp on Slave River; new to the flora of Mackenzie District.

DESCURAINIA SOPHIA (L.) Webb.

ALTA: fairly common in sod in sand 7 miles north of Ft. Fitzgerald; MACK: exposed waste land, occasional, Alexandra Falls on Hay River, *Lewis 915;* exposed well-drained fields, predominant, Old Settlement, Hay River, *Lewis 994,* fairly common around buildings, Latham Island, Yellowknife, *2451;* disturbed ground around buildings, rare, Indin Lake, *3457;* disturbed ground around buildings, Contact Lake, *2749.*

An introduced weed that is evidently spreading quickly throughout our area; new to the flora of Mackenzie District.

DESCURAINIA RICHARDSONII (Sweet) O. E. Schulz

MACK: disturbed soil along roadside, rare, Latham Island, Yellowknife, *2662;* scattered along roadside, Eldorado Mine, Port Radium, *2792.*

According to Raup (1936, 1947) and Detling (Amer. Midl. Nat. 22: 481-520. 1939) Hooker (1829-40) was confused in his treatment of this and the following species under the names *Sisymbrium canescens* and *S. brachycarpum.* The specimen cited here from Great Bear Lake is an extension of range of some 250 miles westward into the Pre-Cambrian from the Ft. Norman locality recorded by Raup.

DESCURAINIA PINNATA (Walt.) Britt. var. BRACHYCARPA (Richards.) Fern.

ALTA: weed in grain field, Ft. McMurray, *7217;* MACK: very scattered in sand, waste ground along fenceline, Ft. Smith, *4137;* sand on beach of Slave River, rare, Ft. Smith, *4565.*

Hooker (1829-40) gives the range of *Sisymbrium brachycarpum* as "From Canada to the Arctic Sea...". This range, however, is not borne out by recent collections. The only Mackenzie District specimen cited by Detling (loc. cit.) is a Preble collection from Ft. Resolution and Raup does not record it in any of his papers on our area (1934, 1935, 1936, 1947). Groh (1949) records it from North Fort Vermillion, Alta.

BRASSICA JUNCEA (L.) Coss.

MACK: humus-rich disturbed ground by buildings, rare, Indin Lake, *3434.*

Introduced; not previously recorded for Mackenzie District.

BRASSICA RAPA L.

MACK: sand in cultivated area, rare, north end of Kam Lake, Yellowknife, *3520.*

Introduced; not previously recorded for Mackenzie District.

CARDAMINE PENNSYLVANICA Muhl.

MACK: in silt under overhanging cliff, Little Buffalo River, 32 miles west of Ft. Smith, *Loan 56;* dried portion of exposed pond, occasional, West Channel, Hay River, *534, 706.*

According to Raup (1935, 1947) this species is common in upland muskegs in Wood Buffalo Park. Hooker (1829-40) records it as "...to the shores of the Arctic Sea" but apparently these are the first collections with specific locality data from Mackenzie District.

CARDAMINE PARVIFLORA L. var. ARENICOLA (Britt.) O. E. Schulz

MACK: gravel road bank, rare, road in to Kam Lake, Yellowknife, *2313;* sandy soil at edge of road, the lush specimens were growing among tall grass, fairly common but localized, just west of new townsite Yellowknife, *2508;* fairly common in pure sand near swimming beach at Sand Lake, Yellowknife, *3141.*

Fernald (1950) records the following range for this entity: "n.Fla. to Tex., n. to. s. N.S., sw. N.B., centr. Me., sw. Que., Thunder Bay Dist., Ont., Wisc. and Minn.; Oreg. to s. B.C." Groh (1949) recorded it from Notikewin in the Peace River District, Alberta (specimen in DAO), apparently the first record for Alberta. The Yellowknife collections form

a northward extension of range of some 400 miles from the Notikewin stand. New to the flora of Mackenzie District.

CAPSELLA BURSA-PASTORIS (L.) Medic.
MACK: exposed sandy shore, Brabant Island, Great Slave Lake, *Lewis 1000;* Yellowknife Bay, *McIntyre 1822;* scattered in sandy gravel, airstrip, Yellowknife, *3227;* moist sandy soil beside old road, rare, north end of Kam Lake, Yellowknife, *2229;* common in rich moist black peaty soil of cultivated area, Yellowknife, *2334;* disturbed ground around buildings, rare, Indin Lake, *3352.*

An introduced weed; previously known in Mackenzie District from Ft. Smith, Resolution and Ft. Simpson (Raup 1947), and recorded by Hooker (1829-40)" . . . as far north as Great Bear Lake." This latter is a rather doubtful statement, but may nevertheless be true.

CAMELINA SATIVA (L.) Crantz.
MACK: cultivated field, sandy soil, rare, Ft. Smith, *3962;* fairly common in sand in grain field, Ft. Smith, *4688.*

An introduced weed; new to the flora of Mackenzie District.

NESLIA PANICULATA (L.) Desv.
MACK: fairly common in sand in grain field, Ft. Smith, *4687;* open fields, sandy loam soil, common, Ft. Smith, *Loan 246.*

Previously known in Mackenzie District from a single collection from near Ft. Simpson (Raup 1947).

DRABA PRAELTA Greene
MACK: shallow soil among rocks on hillside, rare, Indin Lake, *3415.*

Previously recorded for Mackenzie District from Smith Arm, Great Bear Lake (Porsild 1943), and in the Mackenzie Mountains by Raup (1947).

DRABA NEMOROSA var. LEIOCARPA Lindb.
MACK: Indian camp site, Yellowknife Bay, *McIntyre 1821;* a small patch growing under steps of house, Joliffe Island, Yellowknife, *2080;* very shallow soil on steep rocky hillside, rare, Latham Island, Yellowknife, *2653;* shallow soil by path, rare, rapids at mouth of Prosperous Lake, Yellowknife River, *2185;*

Apparently not previously recorded from east of the Paleozoic boundary in Mackenzie District.

ARABIDOPSIS GLAUCA (Nutt.) Rhyb. (*Sisymbrium salsuginosum* Pall., *Thellungiella salsuginea* (Pall.) O. E. Schulz).
MACK: Salt Plain west of Ft. Smith, common, *3691, 3784;* sand by roadside, rare, fork of Pine Lake and Little Buffalo River roads, 23 miles west of Ft. Smith, *4269.*

Raup (1935) records this species as common on the Salt Plain prairies of Wood Buffalo Park, Alberta. It was therefore certainly to be expected to occur in similar habitats just north of the Alberta—Mackenzie border. Porsild (1943) also records it from the Arctic Coast.

ARABIDOPSIS MOLLIS (Hook.) O. E. Schulz (*Arabis hookeri* Lange)
MACK: humus-rich soil in crevice in bare rocky hillside, only 1 plant found here, Yellowknife, *2064;* shallow soil in crevice of rocky hillside, rare, Joliffe Island, Yellowknife, *2480.*

This is a southward extension of range from the east end of Great Bear Lake.

ARABIS GLABRA (L.) Bernh.
ALTA: rare in disturbed ground along railway right-of-way, Lac la Biche, *6902;* Beaverlodge, *Jenkins 183, 462, 506, Groh s.n.* Aug. 29, 1934; field border, Keg River, *Groh 2932;* low grassland areas south of south slope of Caribou Mountains, *Moss 9422.*

In northern Alberta, previously recorded only from Fort Saskatchewan (Turner 1949).

ARABIS HIRSUTA (L.) Scop. var. PYCNOCARPA (Hopkins) Rollins
MACK: shallow soil in crevice of rocky hillside, near Giant Mine, Yellowknife, *2344;* scattered in humus-rich black sandy soil north of town, Yellowknife, *2546.*

Not previously recorded from east of the Paleozoic boundary.

ARABIS RETROFRACTA Graham var. RETROFRACTA (*A. holboellii* Hornem. var. *retrofracta* (Graham) Rydb.)
MACK: scattered on open hillside, Contact Lake, *2750.*

This may possibly be identical with the collections from Great Bear Lake which Porsild (1943) has named *A. holboellii,* but our plants are biennial while Porsild describes his plants as perennial. The nearest records for *A. retrofracta* are those of Raup (1947) from the upper Mackenzie River some 300 miles to the southwest.

ARABIS RETROFRACTA Graham var. COLLINSII (Fern.) Boivin
ALTA: very shallow soil over igneous rock, Government Dog Camp, Chenal de Quatre Fourches, *3661;* shallow soil on rocky point, below Demicharge Rapids, Slave River, *3627;*
MACK: exposed sand slope of roadside, com-

mon, 24 miles south of Lower Hay River, *Lewis 322;* in shallow soil of crevice in igneous rock, Yellowknife, *2085;* shallow soil in hollows of rock, rare, near Giant Mine, Yellowknife, *2352;* rather rare in shallow soil in crevice of rocky hillside, Joliffe Island, Yellowknife, *2479.*

Not previously recorded for either northern Alberta or Mackenzie District.

DROSERACEAE

DROSERA ROTUNDIFOLIA L.

MACK: in west moss, rare, Contact Lake, *2760.*

Hooker (1829-40) records this species "... as far north as the Arctic Circle," but Raup does not record any specimens from north of Great Slave Lake.

CRASSULACEAE

TILLAEA AQUATICA L.

MACK: flats by old townsite, Yellowknife, *3511, 7318.*

For a discussion of this species see Cody, W. J., A history of *Tillaea aquatica* (Crassulaceae) in Canada and Alaska, Rhodora 56:96-101, 1954.

SAXIFRAGACEAE

SAXIFRAGA NIVALIS L.

MACK: in wet moss on ledge of north-facing cliff, rare, Yellowknife, *3225;* in moist moss over rock, rare, Dome Lake, *3187.*

This is an arctic—alpine species which has not been collected previously in the Great Slave Lake region. The nearest known localities are in the Mackenzie Mountains and at Great Bear Lake.

RIBES AMERICANUM Mill.

ALTA: moist ground in hollow, Lac la Biche, *6838;* scattered on bank by lake, Lac la Biche, *6787;* shrub to 4 ft. in open sedge-grass meadow, Big Island, Lac la Biche, *7073;* gravelly shore, Cold Lake, *Groh 1112.*

Not previously recorded for northern Alberta.

ROSACEAE

AMELANCHIER ALNIFOLIA Nutt. *(A. florida* sensu Raup, *A. sanguinea* sensu Porsild).

MACK: shrub 1 ft., rooted in crevice of rocky hillside, north end of Kam Lake, Yellowknife, *2235;* shrub 16 inches, humus-rich soil at water's edge, rare, Yellowknife, *2272;* sand and gravel hillside, rare, Jackfish Lake, Yellowknife, *2671;* foot of steep rocky hillside by water, south shore of Latham Island, Yellowknife, *2331, 2655;* shrub 12 inches, shallow soil over rock, local, 2 miles up Yellowknife River, *2177;* shrub 10 inches, in sand, rare, outlet of Prosperous Lake, *2895.*

Although known northward along the Mackenzie River to Good Hope, this species has apparently not previously been collected east of the Paleozoic boundary.

RUBUS IDAEUS L. var. ACULEATISSIMUS Regel & Tiling (*R. idaeus* var. *canadensis* Richards., *R. idaeus* var. *strigosus* (Michx.) Maxim.).

MACK: Gordon Lake, *Denton s.n.* no date; shrub 2 ft. around old cabins in disturbed soil. Gunbarrel Inlet, Great Bear Lake, *2851;* shrub 15 inches, in crevice at foot of cliff, scattered, Eldorado Mine, Port Radium, Great Bear Lake, *2794.*

These specimens are apparently from the northeastern limit in Mackenzie District. This species has not been recorded previously from the Pre-Cambrian region north of Great Slave Lake.

RUBUS PUBESCENS Raf. var. PARACAULIS (Bailey) Boivin.

ALTA: beneath willows and alders near border of lake, Mile 97 Mackenzie Highway, *Moss 9139;* MACK: moist peat and moss in clearing of spruce wood, occasional, Alexandra Falls on Hay River, *Lewis 380;* exposed wooded area near road, Lower Hay River, *Lewis 249.*

Previously known from the vicinity of Edmonton (Turner 1949); this is a verification of the doubtful Preble and Cary specimen that Raup (1947) tentatively placed under *R. acaulis;* new to the flora of Mackenzie District.

FRAGARIA GLAUCA (S. Wats.) Rydb.

MACK: sheltered southern exposure of bank, Yellowknife Bay, *McIntyre 1804;* humus-rich soil on rock hillside, rare, Yellowknife, *2275;* shallow soil in crevice of rock hillside, rare, Joliffe Island, Yellowknife, *2481;* shallow humus-rich soil in hollow of rock, rare, north end of Kam Lake Yellowknife, *2234.*

Hooker (1829-40) gives the range of F. *canadensis* as "... Woody county between lat. 52° and 64°, north. *Dr. Richardson . . .*" There are however, apparently no previous records of *F. glauca* from east of the Paleozoic boundary in Mackenzie District.

POTENTILLA MULTIFIDA L.

MACK: sandy areas west of Ft. Smith, *3846, 4195, 4312.*

Duplicates of these collections were distributed as *P. bipinnatifida* Douglas, but are best referred here although they are not quite

typical. The specimens cited here are almost upright in stature, measuring up to 16 inches in height, and have broader leaflets than other collections at hand from Ft. Fitzgerald, Ft. Smith, Hay River, Yellowknife and Gros Cap Island.

POTENTILLA PENSYLVANICA L.
MACK: shallow soil in crevice on rock hillside, Yellowknife, *2465, 3094;* shallow soil over rock, outlet of Prosperous Lake, *2894.*

The only other record from east of the Paleozoic boundary appears to be that of Harper (Raup 1936) from Taltson R. south of Great Slave Lake.

POTENTILLA TRIDENTATA Ait.
ALTA: shallow soil over igneous rock, rare, Ft. Fitzgerald, *4425;* MACK: pure sand by roadside, rare, 1 mile west of Seven Mile Lake, approx. 28 miles west of Ft. Smith, *4666.*

Hooker (1829-40) records this species "...in Canada, and thoughout the woody country, from Lake Huron... as far as lat. 60°..." Raup (1947) states that there have been no recent collections north of Wood Buffalo Park [Alberta] although there is a Richardson specimen in Herb. N. without locality data. This is apparently the first substantiated record of *P. tridentata* for Mackenzie District.

GEUM PERINCISUM Rydb. var. PERINCISUM *(G. macrophyllum* Willd. var. *perincisum* (Rydb.) Raup).
MACK: disturbed ground around buildings, Yellowknife, *2457, 2684, 3478.*

Not previously recorded east of the Paleozoic boundary in Mackenzie District.

GEUM RIVALE L.
ALTA: under *Populus* on slope of river bank, Beaver River, 2 miles south of Briarville P.O., *7170.*

Apparently the only other record of this species from northern Alberta is that of Raup (1934) on the basis of a Brinkman collection from Lesser Slave Lake (No. *4210* (DAO)).

AGRIMONIA STRIATA Michx.
ALTA: flats of stream, under balsam poplar, Assineau River, Lesser Slave Lake, *Moss 9283;* gravelly shore, Cold Lake, *Groh 1107;* High Prairie, *Croh s.n.* Sept. 15, 1934; 1½ miles west of Craigend P.O., *7186.*

These specimens are evidently from near the northern limit in Alberta; previously recorded from Fort Saskatchewan by Turner (1949).

LEGUMINOSAE

MEDICAGO SATIVA L.
ALTA: scattered along roadsides in town, Lac la Biche, *6788;* MACK: on sand hillside [overlooking Slave River], rare, Ft. Smith, *4066, 4521;* exposed sandy areas, Alexandra Falls on Hay River, *Lewis 625, 932.*

Turner (1949) records this species from the Ft. Saskatchewan area; Groh (1949) records it for the area between Peace River and Fort Vermillion but does not cite specimens or specific localities. Not previously recorded for Mackenzie District.

MEDICAGO LUPULINA L. var. GLANDULOSA Mertens & Koch
ALTA: only one plant found along sand roadside 2 miles east of town of Lac la Biche, *6947;* MACK: sand in garden, rare, Ft. Smith, *4686.*

Apparently the only other record of this species for Northern Alberta is that of Turner (1949) from Ft. Saskatchewan; a new introduction to Mackenzie District.

MELILOTUS OFFICINALIS Lam. var. OFFICINALIS
ALTA: along ditch near railway yards, Lac la Biche, *6974;* common along roadsides, more frequent than *M. alba,* Ft. McMurray, *7230;* MACK: fairly common on sand hillside [overlooking Slave R.], only place found, Ft. Smith, *4065, 4520;* exposed sandy slope of roadside, occasional, 24 miles south of Lower Hay River, *Lewis 945;* exposed slope of roadside, occasional, Lower Hay River, *Lewis 1107;* sandy gravel along roadside, north end of Kam Lake, Yellowknife, *2966.*

Recorded by Groh (1949) from several localities in the Peace River District, and by Turner (1949) from Ft. Saskatchewan. It is probably to be found in many localities in northeastern Alberta where it has escaped from cultivation; new to the flora of Mackenzie District.

MELILOTUS ALBA Desr. var. ALBA.
ALTA: scattered along roadsides, Ft. McMurray, *7229;* MACK: on sand hillside [overlooking Slave R.], rare, Ft. Smith, *4524;* exposed sandy slope of roadside, occasional, Alexandra Falls on Hay River, *Lewis 913;* exposed field, common, Old Settlement, Hay River, *Lewis 1137;* exposed slope of roadside, occasional, Lower Hay River, *Lewis 1106;* in sandy gravel, only one plant found, airstrip, Yellowknife, 3236; rare in moist ground of broad roadside ditch between townsites, Yellowknife, *7319.*

Recorded by Groh (1949) from a number of localities in the Peace River District and also by Turner (1949) from Ft. Saskatchewan; Raup does not record it from farther north. Introduced and escaped cultivation; new to the flora of Mackenzie District.

TRIFOLIUM PRATENSE L.
ALTA: in moist soil by small slough along railway, Waterways, *7298*.

Recorded by Groh (1949) as an escape from the Ft. Vermilion Substation, and by Turner (1949) from Ft. Saskatchewan.

TRIFOLIUM REPENS L.
ALTA: small patches along ditches in town, Lac la Biche, *6794*.

The only other record of this species growing outside cultivation in northern Alberta is that of Turner (1949) from Ft. Saskatchewan.

TRIFOLIUM HYBRIDUM L. var. HYBRIDUM
ALTA: rare along ditches in town, Lac la Biche, *6795;* in sand with *Equisetum arvense* near base of bank of Slave River, Ft. Smith, *3922;* exposed slope of roadside, rare, Lower Hay River, Lewis *1105;* sandy gravel along roadside, north end of Kam Lake, Yellowknife, *2969*.

Probably an escape from cultivation; previously known in northern Alberta from Ft. Saskatchewan (Turner 1949); new to the flora of Mackenzie District.

ASTRAGALUS STRIATUS Nutt. *(A. adsurgens* sensu Raup).
MACK: common on sand and gravel hillside, Jackfish Lake, Yellowknife, *2663, 2669, 3204*.

Not previously recorded east of the Paleozoic boundary in Mackenzie District; the only other record for the District is from near the mouth of the North Nahanni River (Raup 1947). To the south, it is known from Wood Buffalo Park, Alberta and southward.

ASTRAGALUS CONIATUS Nutt. *(A. hypoglottis* sensu Raup).
MACK: dry exposed clearing, occasional, Alexandra Falls on Hay River, *Lewis 647*.

The only other record for Mackenzie District is from the junction of the Nyarling and Little Buffalo Rivers (Raup 1947) although it is certainly to be expected in many localities in the southwestern part of the District. According to Raup it is common in Wood Buffalo Park [Alberta].

ASTRAGALUS EUCOSMUS *Robinson*
MACK: open field, occasional, Old Settlement, Hay River, *Lewis 452:* exposed dry field, Old Settlement, Hay River, *Lewis 662;* moist sandy soil in partially cleared area, Yellowknife, *2282;* moist alluvial flats of Baker Creek at Giant Mine, Yellowknife, *2339, 3481;* sandy gravel by roadside, rare, road to airport, Yellownife, *3255;* in sandy gravel, rare, road into Kam Lake, Yellowknife, *2975;* forming clump in shallow soil on hillside, rare, Eldorado Mine, Port Radium, *2799*.

Not previously recorded for the area between Wood Buffalo Park [Alberta] and Great Bear Lake but certainly to be expected there.

ASTRAGALUS YUKONIS M.E. Jones
ALTA: among grass on slope leading down to Athabaska R., Ft. McMurray, *7225;* MACK: prostrate in broad dry roadside ditch, rare, between Salt River and Salt Plain west of Ft. Smith, *4180;* dry sandy slope of roadside, common, Alexandra Falls on Hay River, *Lewis 566;* forming large prostrate patches up to 4 ft. in diameter in sand by roadside, local, only place found, north end of Kam Lake, Yellowknife, *2260, 3252*.

This species, which was described on the basis of specimens from Yukon Territory, has only been recorded three times for the whole Mackenzie basin: Mackenzie River Delta (Porsild 1943) and Simpson (Raup 1947) N.W.T. and Calumet, Alta. (Raup 1936).

OXYTROPIS DEFLEXA (Pall.) D.C. var. SERICEA T. & G. *(O. retrorsa* Fern.).
MACK: lakeshore, rare, Seven Mile Lake, 27 miles west of Ft. Smith, *4676;* very scattered on clay hillside, Seven Mile Lake, 27 miles west of Ft. Smith, *4454;* scattered in silty soil in scrub area, local, Yellowknife, *2717, 3248*.

Not previously recorded from the area between McMurray in northern Alberta and Great Bear Lake. Our specimens belong to the small-flowered phase noted by Barneby (Calif. Acad. Sc. 27: 200, 1952).

VICIA CRACCA L.
ALTA: waste ground by buildings, rare, Ft. McMurray, *7312*.

Apparently the only other record of this introduced species in northern Alberta is that of Turner (1949) from Ft. Saskatchewan.

GERANIACEAE

GERANIUM BICKNELLII Britton
MACK: edge of aspen-pine woods, occasional, Louise Falls on Hay River, *Lewis 908;* wooded hillside, Gros Cap. Is., *Reeder 2897;* shallow soil over rock, rare, Yellowknife, *2715, 2944;* in sand near cemetery by airport, rare; Yellowknife *3266;* sandy gravel by roadside, road into Kam Lake, Yellowknife, *2312, 2971*.

Previously known in Mackenzie District from a single collection made by Raup at Ft. Smith (Raup 1936, 1947).

EUPHORBIACEAE

EUPHORBIA SERPYLLIFOLIA Pers.
ALTA: gravel railway bank, Lac la Biche, *6872*.

Apparently introduced; not previously recorded from the area north of Ft. Saskatchewan (Turner 1949).

CALLITRICHACEAE

CALLITRICHE VERNA L. *(C. palustris L.)*.
MACK: shallow water of stream, rooted in muck, Little Buffalo River, 32 miles west of Ft. Smith, *4737;* suspended in water, West Channel, Hay River, *Lewis 1129;* forming large mat, rooted in muck at edge of small dried-up pond, Yellowknife, *3485;* fairly common in 2-3 inches water, rooted in muck, sedge-grass flats south of town, Yellowknife, *2588;* in 4 inches water rooted in clay, rare, Indin Lake, *3428*.

The only other record of this species between Lake Athabaska and Great Bear Lake is from the northwest shore of Great Slave Lake (Raup 1936).

CISTACEAE

HUDSONIA TOMENTOSA Nutt.
MACK: in pure sand, localized, golf club, Yellowknife, *3477*.

The flowers on our plant are sessile or on very short pedicels and hence belong to the typical variety and not the var. *intermedia* Peck, to which Raup (1936) has referred specimens from Lake Athabaska. The calyx in our plant is maroon, particularly toward the tips, a character which does not seem to have been noted elsewhere. This has been observed in a number of specimens preserved in the Divisional Herbarium but the specimens having this character do not seem to have any geographic range, rather occupying the range of the typical plant which has a green calyx.

Hooker (1829-40) gives the range of *H. tomentosa* "...to as far north as Slave Lake, in several places. *Dr. Richardson.*", but this is apparently the first authentic record from Mackenzie District.

ELAEAGNACEAE

SHEPHERDIA CANADENSIS (L.) Nutt.
MACK: along Brock R. approx. 8 miles directly east of its mouth, *Ross Mackay s.n.* 1951; about 15 miles west of the Horten R., and 15-20 miles from the barren grounds, 67°42'N, 123°00'W, *Ross Mackay* s.n., 1951.

The map in Raup (1947) shows collection localities just east of the Mackenzie River Delta and on the north shore of Great Bear Lake. The collections cited here are a range extension of some 200 miles eastward and 150 miles northward from these localities.

ONAGRACEAE

EPILOBIUM GLANDULOSUM Lehm. var. ADENOCAULON (Haussk.) Fern.
MACK: fairly common in moist peat, Yellowknife, *3327;* common in peat over sand, north end of Kam Lake, Yellowknife, *3522;* scattered in shallow soil over rock and in gravel along stream, west side of Kam Lake, Yellowknife, *2989;* moist shallow soil on hillside, Indin Lake, *3424*.

Apparently not previously recorded from east of the Paleozoic boundary in Mackenzie District, although Raup (1947) states that "Hooker's record for *E. tetragonum,* '. . . throughout the plains to lat. 64° . . .,' probably should be referred to this species, at least in part."

HALORAGIDACEAE

MYRIOPHYLLUM EXALBESCENS Fern.
MACK: rooted in ooze in very shallow water of small lake by old townsite, common, Yellowknife, *3007*.

Apparently no specimens have been recorded from the area between Wood Buffalo Park (Alberta) and Mackenzie River Delta, although Hooker (1829-40) recorded *M. spicatum* "... as far north as Great Bear Lake."

MYRIOPHYLLUM VERTICILLATUM L. var. PECTINATUM Wallr.
ALTA: rooted in ooze of small lake in muskeg area 12 miles north west of Ft. Fitzgerald, *4549;* MACK: suspended in water in sheltered slough, common, West Channel, Hay River, *Lewis 1128*.

The range of this species is given by Fernald (1950) as Nfld. to B.C.; not previously recorded for northern Alberta or Mackenzie District.

HIPPURIDACEAE

HIPPURIS VULGARIS L,
MACK: in small pond in hollow of rock along river, Snare River Power Station, *2641*.

Not previously recorded in the Pre-Cambrian north of Great Slave Lake.

ARALIACEAE

ARALIA NUDICAULIS L.
MACK: sheltered slope of aspen-spruce forest, occasional, Alexandra Falls on Hay River, *Lewis 386.*

This is apparently the only record for Mackenzie District other than the report by Hooker (1829-40): "... throughout the woody country to lat. 64°. *Dr. Richardson,...*"

UMBELLIFERAE

SANICULA MARILANDICA L.
ALTA: in sod of parkland by river, Beaver River, 2 miles south of Briarville P.O., *7146;* moist depression on railway right-of-way, Lac la Biche, *6852;* cleared ground by roadside near Beaver Lake, 3 miles southeast of Lac la Biche, rare, *7131.*

Recorded by Turner (1949) from the Edmonton district. The northern limit of this species in eastern Alberta is apparently Lac la Biche.

CARUM CARVI L.
ALTA: common in flower, but most fruit still immature on June 25, gravel beach, Lac la Biche, *6957.*

Introduced; the only other record of this species in northern Alberta appears to be that of Turner (1949) from Ft. Saskatchewan.

CICUTA MACKENZIEANA Raup
MACK: rooted among rocks in 8 inches water, fairly common at mouth of small creek, Indin Lake, *3405.*

The nearest record for this species is at Yellowknife (Raup 1936), some 100 miles to the south, where the author has also collected it. It is, however, known along the Mackenzie River (Raup 1947) and in the Eskimo Lake Baisin (Porsild 1943).

ERICACEAE

LEDUM GROENLANDICUM Oeder
MACK: shallow disturbed ground over rock, very common throughout area, especially in muskeg, Indin Lake, *3345;* shrub 1½ ft., very common in moss and shallow soil over rock under *Picea glauca,* Beaverlodge Lake, *2728;* shrub 15 inches, scattered in shallow soil on rocky hillside, Gunbarrel Inlet, Great Bear Lake, *2830.*

These collections are from near the eastern limit of range between Great Bear Lake and Great Slave Lake in Mackenzie District.

RHODODENDRON LAPPONICUM (L.) Wahl.
MACK: muskeg, Gordon Lake, *Denton s.n.,* no date; shrub 15-18 inches, rare in hummocky muskeg, Indin Lake, *3453.*

This is an arctic species, the range of which includes the eastern part of Great Slave Lake. The tall stature of the Indin Lake specimen was probably the result of the protected environmental conditions.

CHAMAEDAPHNE CALYCULATA (L.) Moench.
MACK: edge of pond, Gros Cap Island [Great Slave Lake], *Reeder 2874;* shrub 15 inches, shallow soil in hollow of igneous rock, Yellowknife, *2153;* shrub 18 inches, peat area by lake, airstrip, Yellowknife, *2366;* shrub 15 inches, shallow soil at water's edge, rare, Prelude Lake, *3160;* shrub 15 inches, in rock crevices at water's edge, Dome Lake, *3169;* Gordon Lake, *Denton s.n.,* no date; shrub 18 inches, rather rare in muskeg on borders of small lake, Indin Lake, *3451;* shrub 1 ft., moist soil along shoreline, fairly common, Beaverlodge Lake, *2736.*

Although this species is known far to the north at Great Bear Lake and in the Eskimo Lake Basin (Porsild 1943) and Hooker (1829-40) states that it occurs "throughout the woody, and part of the barren country," there do not appear to be any specimens with exact locality data for the area between Great Slave Lake and Great Bear Lake. The collections cited here may be from near the eastern limit in this area. Raup (1936) records a specimen from Resolution on the south shore of Great Slave Lake. It undoubtably occurs east of this locality in Mackenzie District but there do not appear to be any records.

ARCTOSTAPHYLOS UVA-URSI (L.) Spreng.
MACK: fairly common in peat area, Snare River Power Station, *2612;* shallow soil over rock, fairly common, Indin Lake, 3347; sand, Sawmill Bay, Great Bear Lake, *Corcoran 12.*

These collections are probably from near the eastern limit of range between Great Bear Lake and Great Slave Lake. It is also known from Matthews Lake 64°05'N, 111°15'W (Cody and Chillcott 1955).

VACCINIUM MYRTILLOIDES *Michx.* (*V. canadense* Richards.)
ALTA: shrub to 1 ft., scattered in very shallow soil over igneous rock, Ft. Fitzgerald, *4117;* under aspen in sand along roadside 4 miles north of Ft. Fitzgerald, *4726;* shrub 10-20 inches, rare, open areas with *Arctostaphylos* and overstory of *Pinus banksiana,* Halfway House, 7 miles north of Ft. Fitzgerald, *Loan 80;* scattered on sand hillside 12 miles north of Ft. Fitzgerald, *4534;* MACK.: sandy loam soil in white spruce-aspen woods, common locally, height 10 inches, Seven Mile Lake, 27 miles west of Ft. Smith, *Loan 59.*

Hooker (1829-40) records this species as occurring north to Great Bear Lake, but Raup (1936) stated that he had seen no specimens from north of the specimens cited by him [central Wood Buffalo Park, Alberta]. Preble (1908) stated that he collected it at Smith Landing [Ft. Fitzgerald] on June 13, 1903. Presumably the first authentic record for Mackenzie District is that cited here from Seven Mile Lake.

PRIMULACEAE

ANDROSACE SEPTENTRIONALIS L.
MACK: common on sand and gravel hillsides, Yellowknife, *2079, 2110, 2665, 3203;* shallow soil on rocky hillside, scattered, Indin Lake, *3418;* sandy soil, Sawmill bay, Great Bear Lake, *Corcoran 18;* scattered in shallow soil on rocky hillside, Gunbarrel Inlet, Great Bear Lake, *2841;* very shallow soil on rocky hillside, fairly common, Eldorado Mine, Port Radium, *2768.*

Previous records of the occurence of this species in Mackenzie District are from Resolution on Great Slave Lake (Raup 1936) along the Mackenzie River (Raup 1947, Hooker 1829-40) and the Arctic Coast (Macoun and Holm 1921, Cody 1954).

LYSIMACHIA THYRSIFLORA L.
MACK: in shallow water along banks of stream, local, west side of Kam Lake, Yellowknife, *2981.*

Not previously recorded east of the Paleozoic boundary in Mackenzie District.

TRIENTALIS EUROPAEA L. var. ARCTICA (Fisch.) Ledeb.
MACK: moist spruce-poplar woods, rare, Brabant Island, Great Slave Lake, *Lewis 1073.*

The only other record for Mackenzie District is a Russell collection from the junction of Nyarling and Little Buffalo Rivers (Raup 1947), some 100 miles to the southeast.

APOCYNACEAE

APOCYNUM SIBIRICUM Jacq.
MACK: exposed slope above riverbank, common, West Channel, Hay River, *Lewis 973.*

The only other record for Mackenzie District is from Simpson (Raup 1947). To the south Raup states that it is occasional in Wood Buffalo Park [Alberta].

BORAGINACEAE

LAPPULA REDOWSKII (Hornem.) Greene var. OCCIDENTALIS (Wats.) Rydb.
MACK: sandy gravel, rare, airstrip, Yellowknife, *3233.*

Although known as far north as the Eskimo Lake basin (Porsild 1943), this species has apparently not previously been recorded east of the Paleozoic boundary in Mackenzie District.

HACKELIA AMERICANA (Gray) Fern.
ALTA: shallow sand over igneous rock, rare, Ft. Fitzgerald, *4108;* MACK: disturbed ground along Slave River, scattered, Bell Rock, 8 miles west of Ft. Smith, *4373;* moist clay of river bank, rare, Little Buffalo River, 32 miles west of Ft. Smith, *4751.*

The known range of this species is extended northward some 50 miles from the upper Slave River locality recorded by Raup (1935, 1936). New to the flora of Mackenzie District.

LABIATAE

SCUTELLARIA GALERICULATA L. var. PUBESCENS Bentham (*S. epilobiifolia* Hamilton, *S. galericulata* L. var. *epilobiifolia* (Hamilton) Jordal
MACK: Gros Cap Island, *Fredeen 99, Reeder 2875;* among sedge rooted in muck by small lake near old townsite, rare, Yellowknife, *2954;* among sedge by stream, rather rare, west side of Kam Lake, Yellowknife, *2993.*

There do not appear to be any records of this species with exact locality data from the Pre-Cambrian region of Mackenzie District. The Howe specimen from the north shore of Great Slave Lake cited by Raup (1947) may possibly have come from this region.

DRACOCEPHALUM PARVIFLORUM Nutt.
MACK: black sandy soil along border of hay field and *Salix* scrub south of Ft. Smith, *4219;* sand by roadside, rare, Bell Rock, 8 miles west of Ft. Smith, *4405;* sand by roadside, rare, fork of Pine Lake Road and Little Buffalo River Road 23 miles west of Ft. Smith, *4270;* jack pine woods, dry and shady, Little Buffalo River, 32 miles west of Ft. Smith, *Loan 341;* sandy embankment of roadside, occasional, Alexandra Falls on Hay River, *Lewis 437;* shallow soil over rock, rare, Yellowknife, *2355, 2945;* sandy gravel roadsides, etc., Yellowknife, *2972, 3234, 3269,* in sand, very rare, Snare River Power Station, *2636.*

Raup (1947) cites a Richardson specimen from "between Bear Lake and Cumberland House" and a Kennicott collection from Reso-

lution. The Kennicott specimen is apparently the only previous record from Mackenzie District with exact locality data.

PHYSOSTEGIA PARVIFLORA Nutt.
MACK: scattered along banks of river and in damp depressions adjacent to the river, Salt River west of Ft. Smith, *4483, 4596, Loan 137.*

This is an extension of range of some 50 miles northward from the upper Slave River localities cited by Raup (1936). New to Mackenzie District.

GALEOPSIS TETRAHIT L. var. BIFIDA (Boenn.) Lej. & Court.
MACK: a small colony in shallow peat over sand, north end of Kam Lake, Yellowknife, 3532.

Introduced; new to the flora of Mackenzie District. The nearest previous record for this species is at Waterways in northern Alberta (Raup 1936) some 400 miles to the south, where the author has also collected it.

SCROPHULARIACEAE

VERONICA PEREGRINA L. var. XALAPENSIS (HBK.) Pennell
MACK: moist sand of roadside ditch, Seven Mile Lake, 27 miles west of Ft. Smith, *4647.*

This station is intermediate between the localities recorded by Raup: Chipewyan (1936) and Simpson (1947). Hooker (1829-40) gave the range "Throughout Canada to Mackenzie River."

LINARIA VULGARIS Miller
MACK: in sand around Hudson Bay Co. buildings, Ft. Smith, *4089.*

Introduced; new to the flora of Mackenzie District. Turner (1949) records this species as common in the Edmonton district some 450 miles to the south.

CASTILLEJA MINIATA Douglas
ALTA: in sod on railway right-of-way, Lac la Biche, *6913;* cleared ground by roadside near Beaver Lake, 3 miles southeast of Lac la Biche, *7130;* in sod by roadside, east of Lac la Biche Mission, *7042;* along railway, Hines Creek, Peace River District, *Groh 999;* shade of aspens, Beaverlodge, Peace River District, Groh 654; moist thicket, Spirit River, Peace River District, *Groh 950.*

Specimens from Manitoba, Saskatchewan and the lower altitudes of Alberta, belonging to this species, have previously been identified as *C. rhexifolia* Rydb., which is probably a synonym of *C. miniata,* while specimens from the mountains of Alberta and British Columbia have been determined as *C. miniata.*

Pennell (1954) has the following discussion under *C. miniata:* "Hook., Fl. Bor.-Amer. 2:106, 1838. 'Blue Mountains, N.W. America Dougl. Tolmie.' Type, Douglas, plant from Bentham's herbarium, seen in Herb. Kew Gardens; it was credited to the 'Blue Mountains, 1826,' but its isotype from Hooker's herbarium, also now at Kew Gardens, was labeled by Douglas himself 'Common on the low hills west of the Rocky Mountains.' The type is the prevalent large-flowered species of the northern Rocky Mountains and ranges westward, and it was gathered by me (*Pennell 15423*) on July 2, 1931 on the Blue Mountains east of Weston, Umatilla County, Oregon, presumably near Douglas' original station. There must have been some error in Hooker's text in quoting Douglas as saying that the flowers are 'generally altogether shorter than in *C. pallida,*' as the corollas are considerably longer than in any species that has been called by that name."

Rydberg (1900) has the following discussion after his description of *C. rhexifolia:* "This has apparently been included in *C. mineata,* but is in my opinion not nearly related to that species. It is easily distinguished by the different coloration, the broader leaves, the larger flowers and the comparately shorter galea, which is scarcely more than half as long as the tube."

Rydberg (1922) differentiates between *C. rhexifolia* and *C. miniata* as follows:

	C. RHEXIFOLIA	C. MINIATA
calyx	ca 2.5 cm	ca 1.5 cm
corolla	ca 3 cm	ca 2 cm
galea	ca 1 cm	ca 1 cm
lip	ca 4 mm	2.5 mm
bracts	usually entire, rarely the uppermost slightly 3-lobed with a broad middle lobe.	usually 3-cleft with lanceolate lobes, if entire very acute
leaves	oblong-lanceolate to ovate, 3--5-nerved about 5 cm long, from glabrous to densely pubescent.	linear-lanceolate or linear, acuminate, 5--7 cm long, sparingly pubescent

In the Canadian specimens seen, these characters, with the exception of the leaves, which tend to be narrower in the western collections, vary, seemingly without relation one to the other: both large and small flowered specimens with floral bracts ranging from entire to 3–5 parted, occur throughout the area. All are referred to *C. miniata,* the earlier name, although local races may later be found to occur.

The types, which are preserved at Kew (*C. miniata)* and The New York Botanical Garden *(C. rhexifolia),* have not been seen; both were collected in the Rocky Mountains of northwestern United States, and probably belong to the same species.

In Canada, *C. miniata* ranges north through the foothills and mountains of Alberta and British Columbia at least as far north as the Peace River District and then east through the parklands north of the prairie to Manitoba, but apparently does not reach the United States border in the eastern part of its range. It is also found in the Cypress Hills in southern Saskatchewan and Alberta and Pennell (1934) has reported it from southern Alaska. A map of the Canadian distribution as known from specimens in the Divisional Herbarium is given in Fig. 1.

EUPHRASIA DISJUNCTA Fern. & Wieg. var. DOLOSA Boivin

MACK : in moist soil in crevices by lake shore, rare, Indin Lake, *3340* (det. Boivin).

The only locality in Mackenzie District recorded by Boivin (Nat. Can. 75:217-218. 1948) was Great Bear River.

RHINANTHUS KYROLLAE Chab.

MACK : common in moist exposed location beside river, West Channel, Hay River, *Lewis 974;* common at edge of woods, Old Settlement, Hay River, *Lewis* 985; occasional on exposed sandy shore, Brabant Island, *Lewis 1001;* common on moist sand flats by bay, Yellowknife, *3547, 3042.*

Raup (1936) gives the following discussion of this species: "Richardson noted *R. Crista Galli* 'to the shores of the Slave Lake, and to Fort Franklin,' and Harper has a record for *R. oblongifolius* at the 'mouth of Taltson River,' but whether these are all referable to the above is uncertain. The group is poor-

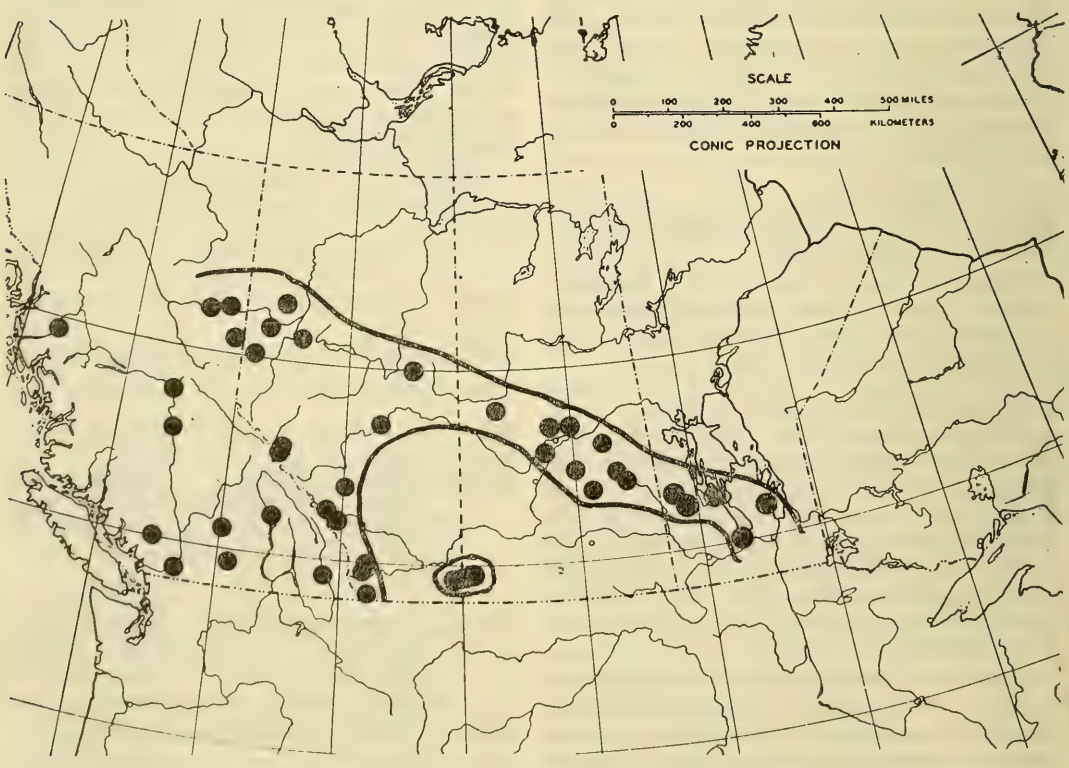


FIG. 1. Distribution of *Castilleja miniata* in Canada

ly understood and badly in need of further material and study." Raup (1947) and Porsild (1943) have referred Mackenzie River specimens to *R. groenlandicus* Chab. Our specimens do not agree with the description of that species.

LENTIBULARIACEAE

UTRICULARIA VULGARIS L.
MACK: in 2 ft. water, Indin Lake, *3406.*

Not previously recorded from the Pre-Cambrian region between Great Slave Lake and Great Bear Lake.

UTRICULARIA MINOR L.
MACK: in 4-5 inches water among *Equisetum,* Yellowknife, *3050.*

The only other record of this species in southern Mackenzie District is from Fairchild Pt. (Raup 1936). Porsild (1943) records it from Great Bear Lake.

UTRICULARIA INTERMEDIA Hayne
MACK: in 2 ft. water, Indin Lake, *3407.*

Not previously recorded from the Pre-Cambrian region between Great Slave Lake and Great Bear Lake.

PLANTAGINACEAE

PLANTAGO MAJOR L.
MACK: disturbed ground around buildings, Yellowknife, *3479.*

Apparently not previously recorded from the Pre-Cambrian region north of Great Slave Lake. It could be introduced at this locality.

PLANTAGO ERIOPODA Torr.
MACK: Salt Plain west of Ft. Smith, fairly common, *3688, 3785, 4480;* rocky exposed slope by river, common, Lagoon, Lower Hay River, *Lewis 338;* beside river on exposed stony slope, common, *Lewis 231.*

Raup (1936) records this species from the Salt Plains of Wood Buffalo Park [Alberta] and it was certainly to be expected in the area just north of the Alberta--Mackenzie District border. Porsild (1943) has recorded it from the arctic coast.

RUBIACEAE

GALIUM TRIFIDUM L.
MACK: bog, Pearson Point, G.S.L., *Fredeen 44:* among sedge, rooted in muck by small lake near old townsite, rare, Yellowknife, *2953;* rooted in moss in shade at mouth of stream, rare, west side of Kam Lake, Yellowknife *2988;* in wet moss along banks of small creek, Indin Lake, *3470.*

The only other record from the Pre-Cambrian region of Mackenzie District is from Muskox Lake (Cody and Chillcott 1955). It is, however, known as far north as the Mackenzie River Delta (Porsild 1943).

GALIUM LABRADORICUM Wieg.
ALTA: wet sedge meadow by small lake 1½ miles southwest of Ft. Smith N.W.T. in Alberta, *4501.*

This is an extension of the known range northward from the Edmonton district (Turner 1949). There is no doubt that *G. labradoricum* will eventually be found in southern Mackenzie District.

CAPRIFOLIACEAE

VIBURNUM EDULE (Michx.) Raf. *(V. pauciflorum* Raf.)
MACK: shrub 15 inches, scattered in humus-rich soil on hillside, Indin Lake, *3359.*

Not previously recorded from the Pre-Cambrian region between Great Slave Lake and Great Bear Lake.

LINNAEA BOREALIS L. var. AMERICANA (Forbes) Rehder
MACK: scattered in patches, prostrate in very shallow soil over rock, Indin Lake, *3361;* shallow soil on rocky hillside, scattered, Gunbarrel Inlet, Great Bear Lake, *2832;* 30 miles S. of Aklavik, *Stevens s.n.,* July 15, 1948.

These specimens are probably from near the northeastern and northern limit of range in Mackenzie District.

LINNAEA BOREALIS L. var. AMERICANA (Forbes) Rehder forma CANDICANS (House) House
ALTA: forming forest mat with *Cornus canadensis* and *Arctostaphylos* in white spruce--birch-poplar wood, Caribou Island, Slave River, 59°43'N, 111°31'W *Loan 6.*

The typical form also occurred at this locality *(Loan 7).* Boivin (Nat. Can. 75: 218. 1948) cites a specimen of this white flowered form collected at Banff, and states that it is apparently very rare. This is the second record for Alberta.

LONICERA INVOLUCRATA (Richard.) Banks
ALTA: shrub to 18 inches along railway embankment, Waterways, *7290.*

Raup (1936) records Lac la Biche, some 130 miles to the south, as the northernmost locality at which he had seen this species, and questions the earlier records of Preble (1908) and the locality data on Richardson's specimen preserved in the Herbarium of the National Museum at Ottawa. Hooker (1829-40) also questions Richardson's record for he

writes "Woody country between lat. 54° and 64°, (but probably confined to the vicinity of the Saskatchewan.) *Dr. Richardson . . .*" The present record from Waterways could quite conceivably be a recent introduction for the species was seen nowwhere else in the area but along the railway embankment.

COMPOSITAE

SOLIDAGO MULTIRADIATA Ait.

MACK: about 15 miles west of the Horten R., and from 15–20 miles from the barren grounds, *Mackay s.n.*, July 1951; on glacial till, along Hornaday River approx. 26 miles directly southeast of its mouth, *Mackay s.n.* July 21, 1951.

These stations are some 250 miles east of sites near the Mackenzie River Delta and 150 miles north of sites on the north shore of Great Bear Lake as shown on the distribution map in Raup (1947).

SOLIDAGO DECUMBENS Greene var. OREOPHILA (Rydb.) Fern.

MACK: exposed dry crevices in rock, rapids on north shore of Christie Bay [Great Slave Lake], *Fredeen 103;* in crevices on rock hillside, very scattered, Yellowknife, *3015;* occasional on sand and gravel hillside, Jackfish Lake, Yellowknife, *2666;* shallow soil in crevice of rock hillside, rare, Joliffe Island, Yellowknife, *3091;* shallow soil on rock hillside, Latham Island, Yellowknife, *2656, 3066;* shallow soil over rock, rare, outlet of Prosperous Lake, *2884;* scattered on open hillside, Yellowknife River Power House, *3314;* scattered in rock crevices, Dome Lake, *3171;* in crevice of rock, rare, Prelude Lake, *3159.*

Not previously recorded east of the Paleozoic boundary in Mackenzie District.

HAPLOPAPPUS LANCEOLATUS *(Hook.)* T. & G. var. sublanatus var. nov.

ALTA: around mud hole in heavy clay soil, three miles east of Beaverlodge, *Jenkins 606;* MACK: rare in sod, Salt Plain west of Ft. Smith (60°03′N, 112°25′W),*W. J. Cody & C. C. Loan 4576* (Type) and *4168.*

Monocephalus rarius bicephalus; folia glabrescentia, in primis a sublanatis lanato-floccosa per ambas paginas; caulis a sublanato lanato-floccosus; hypocephalum dense albolanatum; tegulae a sublanatis lanato-floccosae, lineares, ab acutis acuminatae; involucrum capitis (12)–15–(17) mm. dia.

This northern variety differs from the typical phase by its sublanate to floccose-lanate nature, ususally single heads and narrower tegules. Typical *H. lanceolata* is known in Canada in southern Alberta and Saskatchewan in an area bounded by a line drawn from Pincher Creek northeast to the vicinity of Saskatoon and Big Quill Lake and south to Lisieux. The type is reported to have been collected by Drummond between Carleton House and Edmonton House. On the basis of the presently known distribution it seems probable that it was collected somewhere along the Saskatchewan River near Saskatoon.

ASTER PAUCIFLORUS Nutt.

MACK: very scattered in moist clay, Salt Plain west of Ft. Smith, *4572.*

This species has been collected in similar habitats west of the upper Slave River (Raup 1935, 1936) and was certainly expected to be found north of the Alberta—Mackenzie border. New to the flora of Mackenzie District.

ASTER ANGUSTUS *(Lindl.)* T. & G.

MACK rare in moist sand and gravel by roadside, road to airport, Yellowknife, *3257.*

The type of Hooker's "*B* ramis polycephalis" presumably was collected in the Great Slave Lake area by Richardson. The only other record from Mackenzie District is that of Raup (1947) from near Providence on the Mackenzie River.

ERIGERON ANGULOSUS Gaudin var. KAMTSHATICUS (D.C.) Hara (*E. acris* L. var. *asteroides* (Anderz.) sensu Raup and Porsild).

MACK: sandy gravel soil, Yellowknife, *2547, 2664, 2698, 2965;* disturbed ground, very rare, Yellowknife, *2948;* shallow soil on rocky hillsides, *3018, 3076, 3098;* shallow soil over rock, rare, Prosperous Lake, *2880;* shallow soil over rock, open area, fairly common, Yellowknife River Power House, *3317;* in crevice in moist soil, rare, Indin Lake, *3396;* moist soil on open hillside, rare, Contact Lake, *2748.*

Not previously recorded from the Pre-Cambrian region between Great Slave Lake and Great Bear Lake.

ERIGERON ELATUS (Hook.) Greene (*E. acris* L. var. *arcuans* Fern.)

MACK: moist sandy soil, Yellowknife, *2713;* moist black soil with *Equisetum arvense* along roadside ditch, Yellowknife, *2413;* rich black peaty soil, rather rare, Yellowknife, *2571;* scattered in very shallow soil over gravel by roadside, road into Kam Lake, Yellowknife, *3001;* fairly comomn in humus-rich black soil, north end of Kam Lake, Yellowknife, *2533;* in crevice of rock, rare, Yellowknife River Power House, *3280;* exposed slope from riverbank, common, West Channel, Hay River, *Lewis 731;* common on sand ledge beside

shore, Brabant Island, Great Slave Lake, *Lewis 1014.*

Only one collection has previously been recorded from the shores of Great Slave Lake: Fairchild Point (Raup 1936). The species, however, occurs north along the Mackenzie River at least as far as Good Hope (Raup 1947).

ERIGERON LONCHOPHYLLUS Hook.

MACK: in sod in sand in scrubby pasture south of Ft. Smith, *4320, Loan 43;* scattered on wet sand flats by old townsite, Yellowknife, *3043;* moist black soil by shore, rare, Joliffe Island, Yellowknife, *3095.*

Previously known as far north as central Wood Buffalo Park [Alberta]; new to the flora of Mackenzie District.

ERIGERON COMPOSITUS Pursh var. TRIFIDUS (Hook.) Gray

MACK: shallow soil in crevice of rock, very rare, Indin Lake, *3465.*

Apparently not previously recorded from the area between Great Bear Lake and Great Slave Lake.

ERIGERON CANADENSIS L.

MACK: scattered in clearing in jack pine–aspen woods in sandy loam, Ft. Smith, *Loan 112.*

A northward extension of the known range of some 100 miles from the west end of Lake Athabaska (Raup 1936); new to the flora of Mackenzie District.

ANTENNARIA ROSEA Greene *s.l.*

MACK: on sandy point 2 ft. above water level, Pearson Point G. S. L., *Fredeen 109;* very scattered in rock crevices, Dome Lake, *3172;* very shallow soil over rock along river, rare, Snare River Power Station, *2643.*

Not previously recorded in the Pre-Cambrian region north of the shores of Great Slave Lake.

ANTENNARIA CAMPESTRIS Rydb. var. ATHABASCENSIS (Greene) Boivin

Specimens from Lac la Biche, Lac la Biche Mission, Chenal de Quatre Fourches (58°38′N, 111°20′W), and Ft. Fitzgerald in Alberta and Ft. Smith and Yellowknife in Mackenzie District are referred to this variety. The Howe specimen cited by Raup (1936, 1947) under *A. campestris,* possibly also belongs here. The type of *A. athabascensis* was collected by Preble at Fort Chipewyan.

ANTENNARIA *leontopodioides* sp. nov.

MACK: small clump in very shallow soil in hollow of igneous rock, rare, Indin Lake, 64°17′N, 115°12′W, *W. J. Cody & J. B. McCanse 3473* (Type in DAO).

Humifusa; stolonis curtis suberectis; foliis confertis linearibus vel lineari-spathulatis, 0.8-1.0 cm longis, 1.3-2.5 mm latis, in primis plerumque per ambas paginas coactile tomentosis vel etiam in coactis niveis tectis, maturis appresso-lanato-tomentosis, senectis griseo-tomentosis, apice acutis mucronibus in tomento occultis. Caulis florifer 5-9 cm altus, plerumque basus coactile tomentosus (e tomento ad 3 mm crass.), superioribus floccoso-tomentosis; foliis caulinariis linearibus 8-11 plus minusve imbricatis sericeo-tomentosis, inferioribus mucronatis, superioribus 2-4 summis conspicue scariosis. Inflorescentia glomerata, in primis nutans; pedunculis et involucris basis dense vel coactile tomentosis. Calathia feminea ca. 5 per caulem. Involucrum ca. 5 mm altum; bracteis basis fulvis summis plus minusve roseis, in apice 0.5-1.0 mm latis, minute erosis. Achaenia laevia. Pappus albus barbellatus. Planta mascula ignota.

Humifuse; stolons short, suberect; basal leaves crowded, linear to linear-spatulate 0.8-1.0 cm long, 1.3-2.5 mm wide, the young ones usually thickly carpeted on both surfaces with a lanate tomentum or even hidden in a snowy white mass of lanate tomentum, becoming appressed lanate-tomentose at maturity, grayish-tomentose in age, the mucronate tip hidden by the tomentum; flowering stems 5-9 cm high, usually thickly lanate-tomentose at the base (tomentum up to 3 mm thick), floccose-tomentose above; cauline leaves 8-11, more or less imbricate, linear, sericeous-tomentose, the lower mucronate, the upper 2-4 prolonged into long scarious tips; inflorescence glomerate, nodding when young; peduncles and lower part of the involucre covered with a dense or even felty tomentum; heads about 5 per stem; involucre about 5 mm high; phyllaries light brown below, more or less pink above, the tips 0.5-1.0 mm broad, the margins erose; seed glabrous, pappas white, barbulate; male plant unkown.

From *A. incarnata* with which *A. leontopodioides* appears to be related, it differs in its shorter stolons, shorter flowering stems, glomerate inflorescence, and the very thick lanate tomentum of the young leaves and around the bases of the flowering stems; hence the name, *leontopodioides,* that is, similar to *Leontopodium alpinum,* the heavily white-lanate edelweiss of the Alps.

A specimen collected by A. E. & R. T. Porsild (CAN) at Great Bear Lake, and referred to *A. incarnata* by Porsild (1950) is perhaps

intermediate between *A. leontopodioides* and that species. From the type of *A. incarnata* (CAN) it differs in having shorter flowering stems, a more compact inflorescence and shorter stolons. All the specimens cited by Porsild (loc. cit.) under *A. incarnata* were collected in limestone habitats; the type of *A. leontopodioides* was collected on granitic rock.

BIDENS CERNUA L.
MACK: roadside, moist depression in loamy sand, scattered, Seven Mile Lake, 27 miles west of Ft. Smith, *Loan 174.*

Previously known as far north as central Wood Buffalo Park [Alberta]; new to the flora of Mackenzie District.

HELENIUM AUTUMNALE L. var. GRANDIFLORUM (Nutt.) T. & G.
MACK: exposed slope near riverbank, common, *Lewis 972.*

The first authenticated record from Great Slave Lake and the second from Mackenzie District; see Raup (1947) for discussion of the occurrence of this species in Mackenzie District.

ACHILLEA SIBIRICA Ledeb.
MACK: alluvial soil at mouth of Baker Creek, rare, Yellowknife, *3493.*

Apparently not previously recorded from the Pre-Cambrian region north of Great Slave Lake.

MATRICARIA INODORA L.
ALTA: moist black silt in broad roadside ditch, rare, Ft. Fitzgerald, *4419;* a solitary bushy 3-ft. plant in sand by roadside, 1½ miles north of Ft. Fitzgerald, *4450;* MACK: sand in sod along fenceline, Ft. Smith, *4691;* exposed dry field, occasional, Old Settlement, Hay River, *Lewis 991.*

Pyrethrum inodorum was reported by Hooker (1829-40) "as far north as Bear Lake, Dr. Richardson." Raup (1947) has evaluated this record after seeing Richardson specimens which are without specific locality data preserved at Gray Herbarium and the Herbarium of the New York Botanical Garden, and has concluded that it is probably referable to *Matricaria ambigua* (Ledeb.) Kyrl. The record of *Pyrethrum inodorum* might still, however, be referred to *Matricaria inodora* but in any event the specimens from Ft. Smith and Hay River represent the first clearly substantiated records for Mackenzie District. Introduced; not recorded by Raup (1936) for the Athabaska-Great Slave Lake region.

MATRICARIA MATRICARIOIDES (Less.) Porter
ALTA: disturbed ground along railway right-of-way, Lac la Biche, *6893;* scattered in waste ground and along roadsides throughout the town, Ft. McMurray, *7243.* MACK: very scattered in waste ground along fenceline, in sand, Ft. Smith *4138;* common in moist fill along bay, Yellowknife, *3053;* scattered in sandy gravel, airstrip, Yellowknife, *3235;* scattered in disturbed ground around buildings, Indin Lake, *3343.*

This species has apparently not been previously recorded for the northeastern section of Alberta or the Northwest Territories; it is evidently spreading rapidly throughout the northwest.

ARTEMISIA FRIGIDA Willd.
MACK: open sandy plain, rare, Ft. Smith, *Loan 266.*

Previously known from Wood Buffalo Park [Alberta] (Raup 1935) and along the Mackenzie River (Raup 1947).

ARTEMISIA LUDOVICIANA Nutt. var. GNAPHALODES (Nutt.) T. & G.
ALTA: dry and exposed roadside, Halfway House, 7 miles north of Ft. Fitzgerald, *Loan 217;* under 6-ft. *Salix* bordering exposed saline plain, Salt Plain west of Ft. Smith, *Loan 308.*

Not previously recorded for either the Athabaska-Great Slave Lake area or Wood Buffalo Park; new to the flora of Mackenzie District.

SENECIO VULGARIS L.
ALTA: roadside in partial shade, Lac la Biche, *6955;* rare in disturbed ground along railway right-of-way, Lac la Biche, *6894;* Beaverlodge, *Albright s.n.* August 1942, Jenkins, *165, 358, Lindsay 311;* Kakut Lake near Heart Valley, *Moss 8442;* garden, Grande Prairie, *Groh 888;* east of Grande Prairie, *Groh 2983;* MACK: a weed in market gardens, Yellowknife, *3251, 3528.*

Apparently this weed is advancing northward. It was recorded from the Edmonton district by Turner (1949), but was previously unknown from north of that locality. New to the flora of Mackenzie District.

SENECIO EREMOPHILUS Richards.
MACK: roadside, very sunny and exposed, growing in old burn under aspen regeneration, scattered, Salt River, *Loan 141.*

This species is reported by Hooker (1829-40) as occurring "to Fort Franklin, on the Mackenzie River," but apparently there are no specimens with exact locality data from Mackenzie District to substantiate this state-

ment. The Loan collection represents the first substantiated record for Mackenzie District. Raup (1936) records this species only as far north as the upper Slave River.

SENECIO LUGENS Richards.
MACK: scattered in moist soil on open hillside, Contact Lake, *2746;* in wet moss, rather rare, Eldorado Mine, Port Radium, *2786.*

Hooker (1829-40) records this species "First detected at Bloody Fall, . . . also from Fort Franklin to the sea-coast. *Dr. Richardson.*" In Mackenzie District the species is also known in the Mackenzie Mountains (Raup 1947, Porsild 1945).

SENECIO CYMBALARIOIDES Nutt. var. BOREALIS (T. & G.) Greenm.
MACK: very scattered in shallow soil on rocky hillside, Indin Lake, *3422;* shallow soil on rocky hillside, rare, Gunbarrel Inlet, Great Bear Lake, *2846;* sandy dry land, Sawmill Bay, Great Bear Lake, *Corcoran 1;* scattered in very shallow soil on rocky hillside, Eldorado Mine, Port Radium, *2769.*

Apparently not previously recorded from the Pre-Cambrian region north of Great Slave Lake.

SENECIO INDECORUS Greene
MACK: rare in sandy soil and in moist humus, Yellowknife, *2700, 2714, 2957, 2974, 2976;* in crevice of rock, rare, Yellowknife River Power House, *3279.*

Not previously recorded from the Pre-Cambrian region north of Great Slave Lake.

SENECIO PAUPERCULUS Michx. var. FLAVOVIRENS (Rydb.) Boivin
MACK: moist soil at water's edge, Indin Lake, *3392.*

Not previously recorded from the Pre-Cambrian region between Great Slave Lake and Great Bear Lake.

TRAGOPOGON MAJOR Jacq. (*T. dubius* Scop.)
ALTA: railway, Wembley, *Groh 885;* Beaverlodge, *Groh s.n.,* Aug. 29, 1934; railway right-of-way, Peace River, *2783;* dry bank, roadside, La Glace, *Moss 8527;* MACK: rare, open waste sand area west of Fort Smith, *4131, 4368.*

Introduced; apparently not previously recorded from north of the Edmonton district; new to the flora of Mackenzie District.

TARAXACUM OFFICINALE Weber
MACK: along path and in grass of waste ground, localized, Joliffe Island, Yellowknife, *2476.*

Previously known only as far north as Chipewyan (Raup 1936); new to the flora of Mackenzie District.

CREPIS TECTORUM L.
ALTA: rare in sod along road, Lac la Biche, *6837;* rare on sand beach, Lac la Biche, *6841;* rare in disturbed ground along railway right-of-way, Lac la Biche, *6900;* on sand beach, Lac la Biche Mission, *6983;* rare on sand beach, Big Island in Lac la Biche, *7060;* scattered in hay field 3 miles east of Plamondon, *7090;* rare in railway ballast, Waterways, *7301;* MACK: weed in sandy soil of garden, Fort Smith, *4143, 4410.*

This introduced weedy species is apparently spreading rapidly throughout northern Alberta. Turner (1949) reports first seeing it in 1934 in the Edmonton area, where it has become quite abundant; Groh (1949) records an infestation at Fort Vermillion. New to the flora of Mackenzie District.

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NOTES ON SOME BIRDS AND MAMMALS OF THE COLVILLE RIVER, ALASKA[1]

EDWARD B. REED

Department of Biology, University of Saskatchewan, Saskatoon, Saskatchewan

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During the summer of 1955 the writer and Mr. F. W. Jackson of Pinedale, Wyoming, carried on an investigation of the entomostracan fauna of the Colville River area in northern Alaska. On June 21 we left the junction of the Kiligwa and Colville Rivers in a pneumatic raft. Oliktok Point on the coast was reached August 23. Incidental observations were made on birds and mammals in addition to our plankton work. Except for the setting of a few snap traps no attempts were made to locate birds or mammals, consequently some of the smaller and more wary animals known to occur in the region were not seen. But considering the paucity of records from this area it is felt that the following accounts are of interest.

DESCRIPTION OF AREA

The Colville, the largest river on the Arctic slope of Alaska, rises in the De Long Mountains of the Brooks Range, and flows roughly eastward to its confluence with the Killik, then northeast to the Anaktuvuk from which point it flows nearly due north to the Beaufort Sea (Fig. 1). For most of its length the Colville flows through the Arctic Plateau, a region lying between the high mountains of the Brooks Range on the south and the Arctic Plain bordering the Arctic Ocean to the north. The Plateau is characterized by rolling foothills in a mature well-dissected topography. The first camp was at an altitude of 1800 feet on a gravel bar along the Colville. In this area the river has cut some 200 feet into the rolling hills; the valley is about one mile in width. The flood plain on the valley floor is dotted with numerous little ponds, oxbows, and seeps. Small willows grow along the Colville and tributary streams, whereas the hills are open and rather dry tundra.

The Colville follows a meandering course, often between nearly sheer bluffs. It is free from rocky rapids but there are stretches where the current picks up speed as the river narrows to pass between bluffs. Rapids and rips resulting from currents being deflected by submerged obstacles are frequent. For the last few miles above the Awuna the Colville flows through a series of sharp turns flanked by high hills on each side. Below the Awuna the Colville valley widens and the number of flood plain lakes as well as the amount of willows and alders increases, and except for a few miles above the Killik the bluffs do not closely approach the river on both sides at once.

At the Colville Bar the river divides into a complex series of braids as the valley widens. From the Bar to Umiat the valley floor is about three miles in average width, and the river is characterized by many channels and islands. Fluctuations in water depth of one inch per hour were not uncommon, presumably the result of storms higher up on the drainage area. In this area the growth of willows and alders is quite dense along the streams and around some of the lakes. Also the sides of the hills above the river

[1] These studies were made possible by a contract between the United States Government and the Arctic Institute of North America. Reproduction in whole or in part is permitted for any purpose by the United States Government.

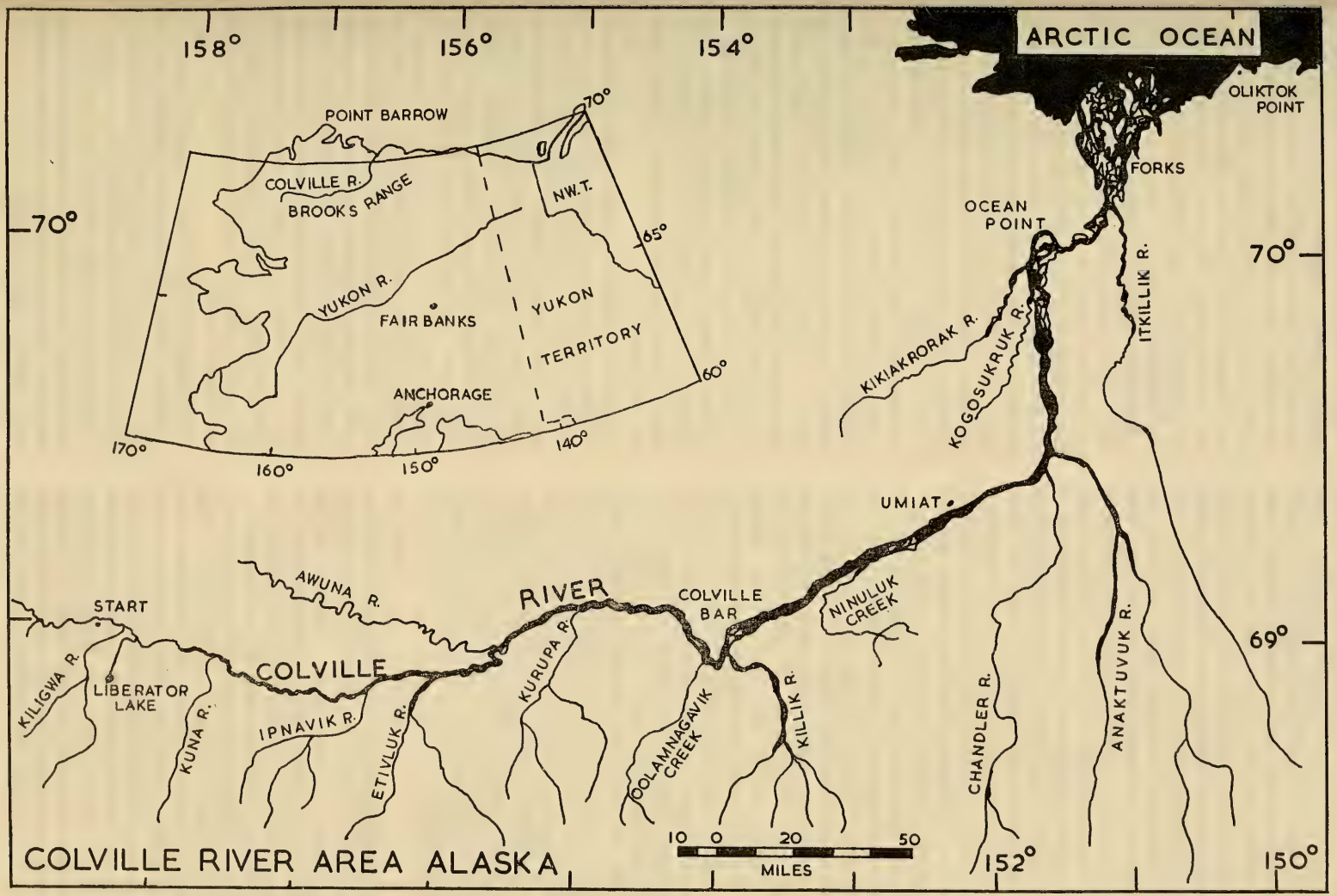


FIG. 1. Colville River area, Alaska

are, in some places, thickly covered by these bushes.

The west bank of the Colville is a nearly continuous bluff that varies in height from 550 at Umiat to 200 feet at the Kikiakrorak. In general the river flows in better defined channels here, although local areas of braiding occur and there are many islands. The high-water mark on the banks was some ten feet above the water level of late July and early August so that extensive sand and gravel bars were exposed. East of the river a much less distinct highland is discernible for a short distance past the Anaktuvuk. The mouth of the Anaktuvuk valley is plain but from there the high ground fades away to the east and south. Willows and alders are plentiful here, as at Umiat. The low ground east of the river is dotted with many small lakes.

Below the mouth of the Kikiakrorak the cliffs continue first on the west, then the north and finally on the east side as the Colville makes a big bend. At Ocean Point the decreasing bluff dies away completely. Here the rolling hills are left behind and the Colville enters the Arctic Plain. Except for low scattered mounds the terrain is without relief. At the mouth of the Itkillik the last willows of any considerable size (4 feet) are seen. The channel from Kikiakrorak to the upper delta is less broken by islands than higher up, but the current is quite slow. About two miles below the Itkillik the Colville begins to break up into the delta distributaries. As the river progresses down the delta the channels become more numerous, wider and more shallow. The tundra from the Itkillik to Oliktok Point is quite flat and dotted with many lakes and ponds separated by areas of dry tundra.

BIRDS

Yellow-billed Loon *Gavia adamsi* — First encountered below the mouth of the Kikiakrorak River on August 6. Common on the river but occasionally seen on some of the larger tundra ponds, not noted below the Forks area. Usually solitary or in pairs.

Arctic Loon *Gavia arctica pacifica* — Common on the river and tundra ponds from start to Oliktok Point. At Kikiakrorak a female was surprised on the nest. At first she crouched down with head and neck pulled close to the body. As I approached the nest she slipped into the water and began feigning injury. This consisted of flapping the wings, raising the fore part of the body from the water and giving a series of low croaky notes. After about two minutes of display the bird swam to its mate that had been swimming and calling some sixty yards from shore. The nest was merely a flattened place on top of a small piece of tundra that had slumped into the lake. One pipped egg lay in the nest. The next day the adults accompanied by the young bird were seen on the lake.

Red-throated Loon *Gavia stellata* — Like the Arctic Loon, this species was common on the river and on the tundra ponds from the starting point to Oliktok Point. Arctic and Red-throated Loons were often observed together on the river but not on ponds. Loons were particularly numerous about the mouth of the Itkillik River, where mixed groups of up to 10 Arctic and Red-throated Loons could be seen. These included adults and young of the year.

Canada Goose *Branta canadensis* — Recorded from start to Ocean Point, most frequently in the area from Colville Bar to Umiat; on this stretch of river 17 pairs each accompanied by six to nine goslings were seen. First goslings were noted on July 5 at Colville Bar. No nests were observed.

Black Brant *Branta bernicla* — Six were observed on a backwater of the Colville a short distance above the mouth of the Etivluk on June 25.

Pintail *Anas acuta* — Recorded at Umiat, Itkillik and Anaktuvuk camps. At the latter a female with seven ducklings was flushed from a very small pond. The young were unable to fly and attempted escape by running into the willows. The sheaths of the flight feathers of one young, captured by hand, were just beginning to split; this was on July 27.

Scaup *Aythya marila nearctica* — Seen at Umiat, June 20 and Kikiakrorak, August 1.

Old Squaw *Clangula hyemalis* — A nest of coarse grasses, lined with down and containing seven eggs was found at Umiat, June 21, at the edge of a small lake. Two pairs were observed on the lake at the starting point. Also noted on tundra ponds at Ipnavik and Kikiakrorak.

Harlequin Duck *Histrionicus histrionicus* — A female with three young believed to be of this species were seen on a large tundra pond at Kikiakrorak, August 1.

White-winged Scoter *Melanitta deglandi* — A flock of 15 was observed on two occasions on tundra ponds at Kikiakrorak and others were seen at Ocean Point.

Surf Scoter *Melanitta perspicillata* — Several were observed on the ocean from the Colville delta to Oliktok Point. A female and four young were seen at Kikiakrorak.

Red-breasted Merganser *Mergus serrator* — Occasionally seen on the Colville above and below Umiat.

Pomarine Jaeger *Stercorarius pomarinus* — Seen over the tundra as scattered individuals from starting point to Oliktok Point. One nest with five eggs was found on the tundra near first camp.

Parasitic Jaeger *Stercorarius parasiticus* — Scattered from start to Forks area.

Long-tailed Jaeger *Stercorarius longicaudus* — Scattered from Ipnavik to Forks. A flock of eight near the Etivluk mouth was the largest concentration of Jaegers noted during the summer.

Glaucous Gull *Larus hyperboreus hyperboreus* — Seen nearly daily from starting point to Oliktok Point. Common on islands in the Colville and frequently seen on the larger tundra ponds.

Arctic Tern *Sterna paradisaea* — Recorded from Kikiakrorak and Itkillik River camps.

American Rough-legged Hawk *Buteo lagopus* — Frequently observed on bluffs along the river from start to Ocean Point. Often nests with young could be seen as we floated past.

Golden Eagle *Aquila chysaetos canadensis* — One individual seen near Ipnavik.

Peregrine Falcon *Falco peregrinus* — Like the Rough-legged hawks, falcons were seen on the river bluffs from start to Ocean Point where the last of the bluffs occur. Adult birds would often circle the raft emitting harsh rapid cries.

Willow Ptarmigan *Lagopus lagopus* — Seen and heard at all camps. A flock of fifty birds was flushed from a dense willow thicket above the Ipnavik River. Ptarmigan were particularly abundant at Anaktuvuk, Ocean Point and Oliktok Point, where many broods were seen.

Rock Ptarmigan *Lagopus mutus* — One individual was seen on Redhill at Umiat on June 16.

Little Brown Crane *Grus canadensis* — Heard at Anaktuvuk on July 27; none seen.

Semipalmated Plover *Charadrius hiaticula semipalmatus* — Recorded from Colville Bar to Kikiakrorak. At Ninuluk Creek we inadvertently pitched our tent about eight feet from a Semipalmated Plover nest. Whenever we approached the nest one of the birds would begin peeping, run in front of us and begin feigning injury. This consisted of widely spreading and depressing the rectrices until the tips touched the ground. Simultaneously the wings were extended outward and downward; then the bird would half flutter and half hop away from the nest. During our stay the four eggs hatched: one the first day, two the second and one the third. At our approach after the young birds were running about, one of the adults would feign injury in front of us while the other attempted to lead the small birds away. The nest was a small unlined hollow in the gravel under an Arctic Lupine.

Golden Plover *Pluvialis dominica* — Recorded at Umiat, June 16, Kikiakrorak, August 1 and Itkillik, August 14.

Black-bellied Plover *Squatarola squatarola* — One individual seen above Umiat.

Wilson's Snipe *Capella gallinago delicata* — Seen at Umiat, Anaktuvuk and Itkillik camps.

Hudsonian Curlew *Numenius phaeopus hudsonicus* — One individual seen on a mud flat by a small stream at Ocean Point, August 9.

Pectoral Sandpiper *Erolia melanotos* — Scattered from Awuna River to Anaktuvuk.

Baird's Sandpiper *Erolia bairdii* — Many were observed feeding on small crustaceans and molluscs along the shore of a large tundra pond at Kikiakrorak.

Semipalmated Sandpiper *Ereunetes pusillus* — Scattered from starting point to Forks.

Northern Phalarope *Lobipes lobatus* — Common on ponds from start to Forks.

Snowy Owl *Nyctea scandiaca* — Two seen, one on June 24 on an open hillside above the Ipnavik River, and one perched in a willow on the bank of the Colville below the Etivluk on June 27.

Short-eared Owl *Asio flammeus* — One individual seen flying over wet tundra at Umiat, June 16.

Northen Raven *Corvus corax* — Recorded at Umiat and Anaktuvuk.

Gray-cheeked Thrush *Hylocichla minima* — A nest with five eggs was noted in low willows at first camp. Thrushes were heard and occasionally seen from there to Umiat.

Red-spotted Bluethroat *Luscinia svecica* — One young of the year was seen in alder bushes at Ocean Point, August 9.

Yellow Wagtail *Motacilla flava* — Common along the tundra-willow edge from Kiligwa to Anaktuvuk. The first fledglings were noted on July 6 at the Colville Bar.

Northen Shrike *Lanius excubitor borealis* — One seen in the vicinity of the Awuna River mouth.

Willow Warbler *Phylloscopus borealis* — Two were observed in the bush along Seabee Creek at Umiat, June 18.

Redpoll *Acanthis hornemanni* and *A. flammea* — No attempt was made to record these species separately. Common from first camp to limit of bushes.

Savannah Sparrow *Passerculus sandwichensis* — Scattered from Awuna to Umiat.

Tree Sparrow *Spizella arborea* — Common from start to Itkillik River. Two nests each with five eggs were noted, one at Umiat, June 17, and the other at first camp June 22. First fledglings were seen on July 6 at Colville Bar. Several fledglings were observed at Ninuluk Creek.

White-crowned Sparrow *Zonotrichia leucophrys* — Scattered from Etivluk to Ocean Point.

Fox Sparrow *Passerella iliaca* — Scattered from start to Ocean Point.

Lapland Longspur *Calcarius lapponicus* — Common on open tundra from start to Oliktok Point. A nest containing one young being fed insect larvae by the female was seen near the Kurupa River mouth. First fledglings were noted at Ninuluk Creek, July 10.

Snow Bunting *Plectrophenax nivalis* — A few were noted at Oliktok Point.

Some birds, either because of their scarcity or the limitations of our movements, were recorded only once or twice. In general the occurrence of redpolls and sparrows coincided with the willow distribution, whereas hawks and falcons tended to be concentrated along the bluffs. Longspurs and jaegers are birds of the open tundra. Willow Ptarmigan were common on the tundra as well as in the bushes. Arctic and Red-throated Loons, Northern Phalaropes and Glaucous Gulls find a continuous habitat on the river and ponds. The lower number of species recorded from near the coast may be the result of decreased availability of habitat and advanced seasonal conditions (Table 1).

MAMMALS

Grizzly Bear *Ursus horribilis* — One seen on June 26 above the Etivluk. This individual was moving about in low willows and alders on the hillside above the river. Tracks were commonly seen on the sand bars in the vicinity of first camp, second camp, Colville Bar, above Umiat, and at Anaktuvuk camp.

Wolverine *Gulo gulo* — One was seen on a gravel bar above the Awuna River on June 29. This animal moved back and forth, occasionally rearing up on its hind legs as the raft floated past. A second wolverine was seen July 5 just above the Colville Bar. We had an excellent view of this animal standing on the river bank as we floated past about 40 feet off shore. After we were some 200 feet downstream the wolverine swam to the opposite shore and disappeared into the willows.

Red Fox *Vulpes fulva* — Fox tracks were seen at every camp, often in considerable numbers. Red fox were seen at first camp on June 21 and June 26, and July 12 at Ninuluk Creek. At the latter place as we aproached our tent from upstream a red fox was trotting toward camp from downstream. We waited motionless to see what would happen. The fox sniffed at our gear piled in front of the tent and nosed about some empty tin cans. Then, on noticing us for the first time, gave a few short barks and withdrew a little way. We remained still and the fox resumed sniffing about the camp and finally passed within eight feet of us, disappearing into the bushes. While the fox was near, a Semipalmated Plover nesting on the sandbar set up a continual peeping and fluttered near the fox feigning injury. As far as we could tell the fox took no notice of the plover.

Arctic Fox *Alopex lagopus* — One was seen July 25 on a sand bar near the mouth of the Anaktuvuk River. This may have been a blue phase animal as it appeared quite dark. However, the dark appearance may have been accentuated by poor light.

Gray Wolf *Canis lupus* — One was seen on a ridge top above the Colville River near the Awuna, June 28. Wolf tracks were seen at all camps through Ocean Point.

Harbor Seal *Phoca vitulina* — Two were seen in the Colville above the Itkillik on August 12, two more above the Forks on August 18. The seals were wary but curious, following the raft for several minutes but staying a hundred yards or so to one side or behind.

Arctic Ground Squirrel *Citellus undulatus* — Seen from first camp to Forks. Particularly numerous on the bluffs at Anaktuvuk and along the small streams entering the Colville at Kikiakrorak area. Frequently seen along the river bank, usually on broken shale or sandy soil. However, at the Forks burrows were found in tundra cracked and buckled

TABLE 1. SOME BIRDS RECORDED ALONG THE COLVILLE RIVER, ALASKA, SUMMER 1955.

	Kiligwa R.	Ipnavik R.	Kurupa R.	Colville Bar	Ninuluk Creek	Umiat	Anaktuvuk R.	Kikiakrorak R.	Ocean Point	Itkillik R.	Forks	Oliktok Pt.
Yellow-billed Loon									*	*	*	
Arctic Loon	*	*	*	*	*	*	*	*	*	*	*	*
Red-throated Loon	*	*	*	*	*	*	*	*	*	*	*	*
Canada Goose	*	*	*	*	*	*	*	*	*			
Black Brant		*										
Pintail						*	*			*		
Scaup						*		*				
Old Squaw	*	*						*				
Harlequin Duck								*				
White-winged Scoter								*	*			
Surf Scoter								*				*
Pomarine Jaeger	*	*	*	*	*	*	*	*	*	*	*	*
Long-tailed Jaeger		*									*	
Parasitic Jaeger	*										*	
Glaucous Gull	*	*	*	*	*	*	*	*	*	*	*	*
Arctic Tern								*		*		
American Rough-legged Hawk	*	*	*	*	*	*	*	*	*			
Golden Eagle		*										
Peregrine Falcon	*	*	*	*	*	*	*	*	*			
Willow Ptarmigan	*	*	*	*	*	*	*	*	*	*	*	*
Rock Ptarmigan						*						
Semipalmated Plover				*	*	*	*	*				
Golden Plover						*		*		*		
Wilson's Snipe						*	*			*		
Hudsonian Curlew									*			
Pectoral Sandpiper			*	*	*	*	*					
Baird's Sandpiper								*				
Semipalmated Sandpiper	*										*	
Northern Phalarope	*	*	*	*	*	*	*	*	*	*	*	
Snowy Owl		*										
Short-eared Owl						*						
Northern Raven						*	*					
Gray-cheeked Thrush	*	*	*	*	*	*						
Red-spotted Bluethroat									*			
Yellow Wagtail	*	*	*	*	*	*	*					
Northern Shrike		*										
Willow Warbler						*						
Redpoll	*	*	*	*	*	*	*	*	*	*		
Savannah Sparrow		*	*	*	*	*						
Tree Sparrow	*	*	*	*	*	*	*	*	*	*		
White-crowned Sparrow		*	*	*	*	*	*	*	*			
Fox Sparrow	*	*	*	*	*	*	*	*	*			
Lapland Longspur	*	*	*	*	*	*	*	*	*	*	*	*

by frost. Here on August 19 a squirrel with wet pelage was picked up on the tundra; this animal was stiff and could barely move. There were no external signs of injury and when placed at the entrance of a burrow the squirrel managed to crawl from sight. At

this time the temperature was 32° F. and intermittent rain and sleet had occurred over the past 12 hours.

Tundra Vole *Microtus oeconomus* — Two were caught at Umiat on June 21. One was a mature male (testes 9.0 mm.) and the other a nonpregnant female one-fourth grown.

Singing Vole *Microtus miurus* — Four subadults were trapped at Ocean Point on August 8 and 9, measurements for three males are — testes: 2.5, 2.5, 2.5; total length: 124, 125, 129; tail: 22, 20, 20; hind foot: 18, 17, 18; ear to notch: 11, 11, and 12 mm. Much vole sign and several voles were seen on the tundra around first camp; however none were collected.

Alaska Moose *Alces alces gigas* — Moose were seen as follows: June 28, bull a few miles above Awuna; July 4, cow above Colville Bar; July 5, three cows, one calf, Colville Bar; July 10, calf Ninuluk Creek; July 25, two cows, one calf below Umiat; July 28, bull Anaktuvuk; August 6, bull Ocean Point. Tracks were numerous from Awuna to Anaktuvuk. The skeleton of a bull with huge antlers was found on a small island two or three miles below the mouth of the Kurupa River.

Barren Ground Caribou *Rangifer arcticus* — Most numerous early in the summer. We estimated, based on partial count, that by June 27 2,000 animals, of which about ten percent were calves, had been seen. Most of these were on the north side of the Colville moving upstream. In addition the following were noted: band of thirty to forty at Ipnavik, scattered small groups and individuals between Etivluk and Kurupa, four swimming the Colville above Umiat, one bull at Kikiakrorak, nine at Ocean Point, three at Itkillik, few at Forks and five at Oliktok Point. A very young, perhaps stillborn, dead fawn was found at the Kurupa mouth.

At Kikiakrorak as I was returning to camp from a day of pond sampling I chanced upon a bull lying on a little hummock in the tundra. While I was still 300 to 400 yards away and down-wind, the caribou got up and began to trot about, first one way then another but gradually moved on a course which took him down-wind from me. From a point about 200 yards away, the caribou approached until within 100 yards and at this distance followed me for about ¾ of a mile, moving at a slow trot, but pausing occasionally to look and always raising his tail before trotting a few steps more.

SUMMARY

Field notes were obtained on 48 species of birds and 11 species of mammals along 450 miles of the Colville River in Arctic Alaska during the summer of 1955. These observations were made secondarily to other work, hence are not exhaustive but perhaps will add to the growing fund of information regarding arctic and high boreal fauna.

SOME DISTRIBUTIONAL NOTES ON CANADIAN BIRDS

W. EARL GODFREY

National Museum of Canada, Ottawa, Ontario

Received for publication January 27, 1956

PIED-BILLED GREBE *Podilymbus podiceps podiceps* (Linnaeus)

Near Scotsville, Cape Breton Island, the writer counted nine adults on July 5, 1954, and later, on July 19 and 20, near Grande Anse, saw an adult passing food to a flightless young bird, the latter certainly indicating breeding. This species has not previously been recorded from Cape Breton Island.

SNOWY EGRET *Leucophoyx thula thula* (Molina)

The bill, feet, and wings of a Snowy Egret, freshly killed, apparently by collision with a telegraph wire, on November 5, 1955, at St. John's, Newfoundland, were forwarded to the National Museum by Leslie M. Tuck. Peters and Burleigh (1951) report five seen (one collected) at Trepassy on August 18, 1948, the only other Newfoundland record.

LITTLE EGRET *Egretta garzetta garzetta* (Linnaeus)

The skin of a female, shot at Flat Rock, Conception Bay, Newfoundland, on May 8, 1954, was forwarded to the National Museum by L. M. Tuck. This is the first North American record for this Old World heron.

GREENLAND WHITE-FRONTED GOOSE *Anser albifrons flavirostris* Dalgety and Scott

A specimen shot at Debert, Nova Scotia, on November 21, 1949, was donated to the National Museum by Robie W. Tufts.

BLUE-WINGED TEAL *Anas discors* Linnaeus

The writer observed it on Cape Breton Island in 1954 on the following dates (number of individuals in parentheses): On Madame Island June 4 (1); at Indian Bay June 6 (4), 8 (1), 11 (1), 12 (2), 13 (2), 15 (2), 27 (2), 29 (3); July 12 (2 ad., 3 downies), 15 (2); at Nyanza June 6 (4); Margaree Forks, July 7 (1); East Margaree (2 ad., two broods of 12 and 2 young respectively). Breeding of this species does not appear to have been previously recorded from Cape Breton Island.

RING-NECKED DUCK *Aythya collaris* (Donovan)

Although apparently not previously recorded from Cape Breton Island this duck is locally not uncommon there in summer, breeding in freshwater marshes. In 1954 the writer counted 26 adults in the marshes of Indian Bay, Inverness County, on June 6 and three at Nyanza on June 15. At the outlet of Lake Ainslie broods of 6 and 9 respectively were seen on July 5. On the west side of Lake Ainslie nine downies were noted on July 7. At East Margaree 17 adults and 17 downies were counted on July. Three broods of young were seen on Indian Bay on July 15; and on a small lake near Sydney an adult with 7 young were seen on July 25 and 26.

Another range extension is indicated by banding records of the Canadian Wildlife Service made available by T. S. Hennessey. At a banding station near Baie Johan Beetz, at Lac Salé, Quebec, north shore of the Gulf of St. Lawrence, 88 Ring-necked Ducks were banded in 1949; 9 in 1950; 36 in 1952; 18 in 1953. F. Graham Cooch, who operated the station in 1950, has informed me that he observed two broods of young there on September 17 of that year.

OLD-SQUAW *Clangula hyemalis* (Linnaeus)

Four were observed regularly by the writer between July 17 and 28, 1954, in a bay of Madame Island, Cape Breton, Island, an unusual summer record so far south.

ICELAND BLACK-TAILED GODWIT *Limosa limosa islandica* Brehm.

The skin of a female, taken at Dunn's Pond, Placentia Bay, Newfoundland, on May 20, 1954, was donated to the National Museum by L. M. Tuck. Dr. Alexander Wetmore, who has recently investigated the validity of the subspecies *islandica,* refers this specimen to that race. This is the first record of the species for Canada, the only other North American record being from Greenland.

FORSTER TERN *Sterna forsteri* Nuttall

The writer examined a mounted immature specimen in the collection of the Nova Scotia Museum of Science which was taken at Maynard's Lake, near Dartmouth, Nova Scotia, on September 4, 1924, apparently the first Nova Scotia record.

NORTHERN BARRED OWL *Strix varia varia* Barton

A female in the flesh, forwarded to the National Museum by Leonidas Gagne, was picked up unable to fly with badly frozen legs and feet at Lake Patterson, Mistassibi watershed (Lat. 50° 11′ N), on January 17, 1954.

EASTERN MOCKINGBIRD *Mimus polyglottos polyglottos* (Linnaeus)

At Deroche Pond, Queen County, Prince Edward Island, the writer collected an adult female on August 4, 1952. Although the bird had an incubation patch it may have been a post-breeding-season wanderer. This is the first record for Prince Edward Island (Godfrey 1954).

CATBIRD *Dumetella carolinensis* (Linnaeus)

In alders along the Aspy River, near Cape North, Cape Breton Island, the writer collected a singing male on June 22, 1954. Another was observed in willow shrubbery at Scotsville on July 5, 1954. The Catbird has not been previously recorded from Cape Breton Island.

BICKNELL GRAY-CHEEKED THRUSH *Hylocichla minima bicknelli* Ridgway

Wallace (1939) mentions three specimens taken near Percé, Quebec, in June and July. Two are referable to *bichnelli,* one to the

Newfoundland population of the nominate race. On July 12, 1955, R. J. d'Entremont secured three additional specimens in the hills behind Percé. All are referable to *bicknelli.*

NEWFOUNDLAND YELLOW WARBLER *Dendroica petechia amnicola* Batchelder

The wings and some attached dorsal feathers from a specimen picked up early in August, 1951, by an Eskimo on Southampton Island, N.W.T., were forwarded to the National Museum by Niall Rankin.

SYCAMORE WARBLER *Dendroica dominica albilora* Ridgway

A specimen collected by Leslie M. Tuck at St. John's, Newfoundland, on November 11, 1955, was donated by Mr. Tuck to the National Museum. Several other warblers, believed to be of this species, were seen there at the time. The specimen, unsexed, is somewhat intermediate in racial characters but seems nearest to *albilora.* This appears to be the first specimen of this species collected in Canada although sight records have been reported.

SCARLET TANAGER *Piranga olivacea* (Gmelin)

A family group consisting of an adult male and female and a juvenal (suggesting breeding) were observed near Rivière du Loup, Quebec, on July 21, 1955, by R. J. d'Entremont and the writer. The adult male and juvenal were collected.

RED-EYED TOWHEE *Pipilo erythrophthalmus erythrophthalmus* (Linnaeus)

A post-juvenal male was secured by S. D. MacDonald at Northport, Nova Scotia, on October 27, 1949. This appears to be the first definite record for Nova Scotia.

CHURCHILL SAVANNAH SPARROW *Passerculus sandwichensis oblitus* Peters and Griscom

An unsexed specimen was collected at Resolute Bay, Cornwallis Island, N.W.T., on September 4, 1954, by J. A. Crosby. This is the northernmost North American record.

EASTERN GRASSHOPPER SPARROW *Ammodramus savannarum pratensis* (Viellot)

On June 25, 1952, some five miles northeast of St. Peters, Prince Edward Island, the writer collected an adult male Grasshopper Sparrow. It had been singing, appeared to have a definite territory, and its testes were fully enlarged. No others were seen, however, although a considerable search was made. It has not been previously recorded from Prince Edward Island (Godfrey 1954).

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ANNOTATED LIST OF BIRDS OF PART OF THE BACK RIVER, N.W.T.

JOHN S. TENER

Canadian Wildlife Service, Ottawa, Ontario

Received for publication October 3, 1955

From July 31 to August 9, 1955, Mr. Lloyd Beebe, Sequim, Washington, and I were on the Back River system, N.W.T. We flew from Yellowknife, N.W.T. to Beechy Lake, and then down the Back River to the Baillie River where we landed. July 31 and August 1 and 2 were devoted to a wildlife reconnaissance at the junction of the Back and Baillie Rivers, with one day spent in traveling ten miles up the latter river. On August 3 we paddled down the Back River arriving at Pelly Lake in the evening of August 7. On August 8 we made a short reconnaissance around our campsite and on the 9th we left by air. Observations of birds and mammals were recorded and plants collected.

The observations of two earlier travelers on the relevent portion of the Back River have been published. King's wildlife observations made during a trip down the river in 1834 were prepared for publication by Richardson and published in Back's (1836) journal. James Anderson did not publish the journal of his trip down the Back River in 1855, and it was not until 1940-41 that the information contained in it was printed. Clarke (1940-41) edited and published this interesting document.

A party from the University of Minnesota spent several weeks in 1953 on a section of the Back River below Macdougall Lake. Their observations of thirty species of birds were published by Breckenridge (1955). Essentially the same avifauna was found by both his party and ours.

Our trip was necessarily brief. The following annotated list must be considered as an incomplete record of the avifauna of the region traveled. Identification was by sight only, as no specimens were collected.

I am indebted to Mr. W. E. Godfrey, National Museum of Canada, for reviewing the manuscript and for identifying blue feathers found in a peregrine falcon's nest as those of a mountain bluebird.

YELLOW-BILLED LOON *(Gavia adamsi)*

Only one individual of this species was encountered, an adult one mile above the Hawk Rapids on the Back River, August 6.

COMMON LOON *(Gavia immer)*

The first individual of this species was seen August 3 at the mouth of the Baillie River and the second on the 5th near the mouth of the Jervoise River. No other birds were noted.

PACIFIC LOON *(Gavia arctica)*

A Pacific loon was observed five miles below the Hawk Rapids August 6, and three more were observed the next day opposite the mouth of the McKinley River. These latter birds exhibited the curious behavior of emitting a sharp cry each time they submerged. The cry was quite high pitched and stopped only by submersion.

RED-THROATED LOON *(Gavia stellata)*

This was the most common loon encountered, birds being observed every day, both on the Baillie and on the Back Rivers. Young of this species were seen flying August 3, below the mouth of the Baillie River.

WHISTLING SWAN *(Olor columbianus)*

A small flock of three was seen from the air July 31 on the Back River, twenty-two miles below Beechy Lake.

CANADA GOOSE *(Branta canadensis)*

Canada geese were well distributed in various sized flocks of what appeared to be molting adults, from Beechy Lake to Pelly Lake. Nearly all of the geese were flying, including those on the Baillie River. On August 5 a flock of 35 contained three small individuals which may have been the subspecies *B.c. hutchinsi.*

LESSER SNOW GOOSE *(Chen hyperborea)*

An individual of this species was identified August 6 with a small flock of four Canada geese five miles below the mouth of the Jervoise River. The five geese were grazing undisturbed when sighted but when alarmed by our presence the Canadas attempted to drive away the snow goose as they walked away from us over a ridge.

PINTAIL *(Anas acuta)*

A small flock of three females flew past us August 4, about ten miles above the Jervoise River mouth.

SCAUP (*Nyroca* sp.)

A female, probably of this genus, was sighted August 5 at the mouth of the Jervoise River and two more were recorded four miles below this river the next day.

AMERICAN MERGANSER *(Mergus merganser)*

Commonly distributed from Beechy Lake to Pelly Lake. Several males were sighted but most individuals were females and flightless young.

RED-BREASTED MERGANSER *(Mergus serrator)*

Three females were identified on the Baillie River August 1. No other individuals of this species were seen.

AMERICAN ROUGH-LEGGED HAWK *(Buteo lagopus)*

Two hawks of this species were seen hovering over the foot of the third Hawk Rapids. This is the locale where Back observed a hawk, naming the rapids after it, in 1832. Both individuals were in light phase.

GOLDEN EAGLE *(Aquila chrysaetos)*

An adult was encountered August 5 near a sand cliff on the south bank of the Back

River, five miles above the mouth of the Jervoise River.

PEREGRINE FALCON *(Falco peregrinus)*

An adult peregrine was sighted at the third Hawk Rapids and a pair, with four young in a nest, was photographed fifteen miles below the rapids. The nest was in a narrow canyon of the river fifty feet above the water. The young were developing post-juvenal plumage.

SEMI-PALMATED PLOVER *(Charadrius hiaticula)*

On August 4 an immature plover of this species rested on the shore of the Back River, 30 miles below the mouth of the Baillie.

GOLDEN PLOVER *(Pluvialis dominica)*

Three birds of this species were found singing on a hillside of the Back River in the evening of August 3.

BAIRD'S SANDPIPER *(Erolia bairdii)*

Individuals were seen from the Baillie River to Pelly Lake and several small flocks were recorded near the head of this lake on August 8.

NORTHERN PHALAROPE *(Lobipes lobatus)*

An adult was found on a small pond two miles north of the Back River, twenty miles below the Baillie River mouth.

PARASITIC JAEGER *(Stercorarius parasiticus)*

Common throughout the area traveled. Young were flying at the time of our trip.

An unusual performance by three jaegers was recorded August 2 at the mouth of the Baillie River. An adult cow caribou was feeding on a plateau when the three birds flew toward it and swooped and harried it. The caribou rose on its hind legs and struck at the birds with its forefeet. The jaegers approached from all sides, with the caribou turning in an attempt to meet each bird. The jaegers flew away after about a minute's sustained attack.

LONG-TAILED JAEGER *(Stercorarius longicaudus)*

Only two individuals of this jaeger were seen, being near the Baillie River mouth on August 1.

HERRING GULL *(Larus argentatus)*

Commonly found from the Ballie River to Pelly Lake.

ARCTIC TERN *(Sterna paradisaea)*

Common from the Baillie River to Pelly Lake. Young birds were able to fly and small flocks were seen foraging along the Back River below the McKinley River. A pair of terns attacked briefly a caribou fawn at the Baillie River mouth. The fawn rose on its hind legs to fend off the birds, rearing its head back as it did so.

HORNED LARK *(Eremophila alpestris)*

A few individuals were sighted each day throughout the trip. Immature birds were flying.

MOUNTAIN BLUEBIRD *(Sialia currucoides)*

A few feathers of this species, identified by Mr. Earl Godfrey, National Museum of Canada, were found August 6 amid remains of food near a nest of peregrine falcons, fifteen miles below the Hawk Rapids on the Back River.

There are three records of particular interest of the mountain bluebird in the Mackenzie District. Richardson (1831) reported collecting a specimen at Fort Franklin in July 1825. He also reported (in Back, 1836) a specimen collected on Great Slave Lake by King. Williams (1922) recorded seeing a bluebird August 8, 1921, at Rocky-by-the-Riverside, Mackenzie River. The present specimen constitutes a northeastern record for the species.

REDPOLL *(Acanthus flammea)*

Redpolls were relatively numerous along the Back River, being recorded every day.

SAVANNAH SPARROW *(Passerculus sandwichensis)*

One individual was seen August 2 at the Baillie River mouth.

LAPLAND LONGSPUR *(Calcarius lapponicus)*

Individuals were encountered from the Baillie River to Pelly Lake and small flocks were seen at the latter site. Two extremely emaciated, dead longspurs were found on the tundra near the Jervoise River.

SNOWBUNTING *(Plectrophenax nivalis)*

Commonly distributed throughout region traveled. Adults in full winter plumage were noted August 8 at Pelly Lake.

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NOTES

Orobanche uniflora L. from Yarmouth County, Nova Scotia

A cluster of *Orobanche uniflora* L. was found under a dense growth of alder shrubs near Wedgeport, Yarmouth County, Nova Scotia.

This confirms A. E. Roland's assumption that *O. uniflora* is "scattered from Kings Co. to Pictou, and probably beyond" (Proc. N. S. Inst. Science 21: 95-642. 1944-45).

The specimen (collector's number *1337*, June 6, 1954) has been placed in the Herbarium of Vascular Plants, University of Toronto.

This note is a supplement to my "Additions to the Flora of Yarmouth County, Nova Scotia" (Can. Field Nat. 69: 129. 1955).

W. L. KLAWE

Inter-American Tropical Tuna Commission
Scripps Institution of Oceanography
La Jolla, California

Clay-colored Sparrow Nesting in Grey County, Ontario

During a field day held by the Toronto Field Naturalist Club on the weekend of May 24, 1952, at Craigleith in Grey County, Ont., a singing Clay-colored sparrow *Spizella pallida* was discovered by a member of the party, George Francis of Toronto, Ont. The writer made several visits to the location, an old pasture field overgrown with hawthorn bushes, wild rose bushes and wild apple, a typical habitat for this western sparrow, and discovered a colony of this species, some three or four pairs. On June 12, 1952, the writer found a Clay-colored Sparrow nesting, in a wild rose bush eight or ten inches from the ground in this locality with a singing male in attendance a few yards from the nesting female. A colored photograph was secured of the nest and four eggs. Although the Clay-colored Sparrow has been recorded twice in adjacent Simcoe County (no nesting record), this apparently is the first record of the Clay-colored sparrow nesting in Grey County.

73 Market Street
Collingwood, Ontario
A. J. MITCHENER

Great Gray Owl Near Black Sturgeon Lake, Ontario

On July 9, 1954, K. R. Elliott, an entomologist with the Black Sturgeon Lake Field Station, flushed a Great Gray Owl *Strix nebulosa* from the edge of a black spruce forest while walking across country near black Sturgeon Lake, Ontario. The bird was very large, had conspicuously yellow eyes, facial discs that extended to the top of the head, and had no ear-tufts. It was roosting less than six feet off the ground in a small, dead spruce, and it allowed Elliott to approach within 15 feet before it flew. The experience was recounted to R.F. James and N.D. Martin, two ornithologists working in the area, and on July 24, Elliott, James, and Martin returned and found the owl in almost the same place. This time it was seen at less than ten feet by James, who identified it immediately as a Great Gray Owl from the same characteristics. It was sitting less than six feet above the ground on a spruce stump, and when flushed it flew a hundred yards out into a cutover area. Elliott circled behind it and chased it back into the black spruce forest. Each time it flew, it did not rise more than three feet above the ground, weaving between bushes and shrubs. After the initial approach, it was not possible to come closer than 200 feet to the bird. On August 7, Martin and a companion revisited the area, but the bird was not found.

K. R. ELLIOTT, R. F. JAMES
and N. D. MARTIN

A First British Columbia Record of the Cragonid Shrimp

An oceanographic survey of inlets of the British Columbia coast was conducted by the Institute of Oceanography of the University of British Columbia during the summer of 1951. Mr. F. H. C. Taylor of the Pacific Biological Station, Nanaimo, B.C., accompanied the survey as biological observer. In the biological collections made by Mr. Taylor were included thirty-three species of decapod crustaceans, representing nine families.

Seven specimens of the Cragonid Shrimp *Sclerocrangon boreas* (Phipps) were collected in an otter trawl at a depth of 10 to 20 feet in Dean Channel on July 20, 1951. These individuals constitute a first record in British Columbia waters. *Sclerocrangon boreas* was recorded previously in the Atlantic Ocean from Labrador to Cape Cod, east and west Greenland; the Arctic Ocean, and in the Pacific Ocean to the Aleutians and northeast Siberia. The bathymetric range is 0-140 fathoms (Rathbun, M.J. Decapoda, Canadian Atlantic Fauna, 10 m. 1929).

The seven specimens (5 ♀, 2 ♂) from Dean Channel ranged in length 54 mm to 68 mm. These specimens differ somewhat in body proportions from Rathbun's *(op. cit.)* description. They showed the carapace length to be 1.25 the carapace width, whereas the carapace length of specimens examined by Rathbun was reported as 1.20 the carapace width.

T. H. BUTLER

Pacific Biological Station
Nanaimo, British Columbia

Additional Records of Bats in Saskatchewan

In a survey of small mammals conducted in Saskatchewan during the summer and autumn of 1953, two interesting bats were collected. They are Trouessart's mouse-eared bat *Myotis keenii septentrionalis,* a female (measured from preserved specimen) total length 91 mm.; tail vertebrae 39 mm.; hind foot 9.5 mm.; ear 15.2 mm.; tragus 9.0 mm.; and the pale big brown bat *Eptesicus fuscus pallidus,* a male; total length 109 mm.; tail vertebrae 38 mm.; hind foot 8 mm.; ear notch (dry) 15.9 mm.; tragus (dry) 6.0 mm. Two further specimens were a male, total length 108 mm.; tail vertebrae 42 mm.; hind foot 11 mm.; ear (dry) 13 mm.; tragus (dry) 6 mm., and a preserved male specimen total length 103 mm.; tail vertebrae 38 mm.; hind foot 12 mm.; ear 16 mm.; tragus 6 mm.

The Trouessart bat was taken in the northern settlement of Buffalo Narrows on Churchill Lake in August, 1953. It was found beneath the warped bark of a black poplar on the fringe of a dense stand. Within this stand were found two other species, the little brown bat *Myotis lucifugus lucifugus,* also beneath the poplar bark, and the silver-haired bat *Lasionycteris noctivagans* found in an abandoned woodpecker hole. The latter species was represented by a family group including young which were feeding on an accumulation of living dipterous larvae at the bottom of the nest. *L. noctivagans* was also collected by D.S. Rawson on Frobisher Lake in the Precambrian area and some 50 miles north of Buffalo Narrows.

The first pale big brown bat was found in a barn loft on the outskirts of the city of Saskatoon in October, 1953. The two further specimens were taken in buildings on the University of Saskatchewan campus.

A check on the distribution of Trouessart's mouse-eared bat shows no record of its occurence in either Alberta or Saskatchewan (Anderson, 1947). This was verified by Dr. R.L. Peterson, Curator, Royal Ontario Museum of Zoology, Toronto, Ontario, who first identified both the Trouessart's bat and the pale big brown bat. Since Buffalo Narrows is approximately 60 miles from the western boundary, it is likely that this species occurs also in Alberta.

The pale big brown bat has been recorded for southern and central Alberta (Anderson, 1947), Wood Buffalo Park (Soper, 1942), with Regina (Anderson, 1947) the only record in Saskatchewan. The Saskatoon occurrence therefore extends the known range of the species in this province north by approximately 150 miles.

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N. S. NOVAKOWSKI

Department of Biology
University of Saskatchewan
Saskatoon, Saskatchewan

Mackenzie River Migration

I have long felt that it would be of interest to many Canadian Field-Naturalist readers to hear first hand of the waterfowl migration taking place on the Mackenzie River during the month of September. During this month in 1954, through the courtesy of Mr. Earl Harcourt, owner-operator of Yellowknife Transportation Company, and Rennie Harley, Western Manager of Ducks Unlimited, I had the good fortune to make the 2200-mile trip by boat from Hay River, on the south shore of Great Slave Lake, to Aklavik on the Mackenzie Delta and return. Numerous waterfowl observations were made. It appears that a great many migrating waterfowl use the Mackenzie River as their highway to the south. Canada Geese, Snow Geese, some Whistling Swans and a great many of the divers such as Redhead, Canvas-back, Bufflehead, mergansers and scaup were particularly numerous.

The most enlightening observation to me was the fact that many rafts of Greater Scaup, almost all males, were using this flyway and concentrating on the weed beds at the west end of Great Slave Lake where the Mackenzie leaves the Lake. These rafts varied in number from 50 to 350 birds. I should like to suggest that there is a strong possibility that the Greater Scaup concentrations at the west end of Great Slave Lake continue their migration on a straight easterly course out the east end of Great Slave Lake and thence on through Manitoba, and the eastern provinces. Greater Scaup are very seldom seen on migration through Alberta but apparently do go across the mountains to the Pacific Coast.

It was quite apparent that the migrating geese and the majority of the ducks move out of the Western Slave Lake area and Mills Lake area (another concentration area particularly for the geese) in a southerly direction. In the past year or two there have been tremendous concentrations of waterfowl at the Ducks Unlimited project at Upper Hay Lakes in extreme northern Alberta. The vast numbers of White-fronted geese at this stopover would indicate that these birds move in from their barren land nesting grounds and, generally speaking, do not use the Mackenzie River flyway.

As an added point of interest I should like to mention that we had the opportunity to observe two rafts of approximately 100 birds each of the Old-squaw Duck. This observation was also in the weed bed area at the west end of Great Slave Lake.

EDGAR T. JONES

6115 141st Street
Edmonton, Alberta

New and Unusual Bird Records for Alberta

Two new records to the lists of Alberta birds that are worthy of mention, even though very belated, are the following:

SAGE THRASHER *Oreoscoptes montanus* Adult male collected by myself at Walsh, Alberta, on June 15, 1940. As far as is known here, there are no other authentic records of this species from this province. The bird appeared to be without a mate and numerous trips into the immediate vicinity of the collection failed to uncover any evidence of nesting activity.

DICKCISSEL *Spiza americana* Adult male collected near Walsh, Alberta, on June 24, 1940. This was one of two adult males seen in the same area, and as both were singing it is most likely that there were setting females on nests in the immediate vicinity. Unfortunately, time was very limited and it was not possible to make a concentrated search for the nests but undoubtedly they could have been found. I understand that there are several other records for Western Canada, but all checking to date has not shown any of them to come from Alberta.

The following unusual records may also be of interest:

BULLOCK ORIOLE *Icterus bullocki* Adult male taken at Walsh, Alberta, on July 1, 1940. Several birds of this species were seen in this area, and although this specimen I collected is not a 'first,' it is nevertheless interesting to note that the species is fairly frequent in this particular area.

BARRED OWL *Strix varia* Adult male caught in a trap on November 18, 1953, by a half-breed trapper in the Calling Lake area, approximately 140 miles north of Edmonton. This interesting specimen turned up in response to a recent booklet circulated to all the registered trappers of northern Alberta concerning the Great Gray Owl. The trapper who caught the bird had thought it was a Great Gray *(Scotiaptex nebulosa)*.

A check of all available data here on the species has revealed that there are several scattered records for the province, but none of recent years. Although the specimen was in poor condition, I mounted it and it will be kept by Mr. Al Oeming of this city. Oddly enough, last year in the month of May, a lone feather of this species was found in the heavy bush country of the Fort Assiniboine area during extensive searches, made by Mr. Al Oeming and myself, for the Great Gray. This feather was kept and has now been positively identified as one from this Barred Owl. For those interested in stomach analyses, 3 Red-backed Mice *(Clethrionomys gapperi)* and 1 Shrew *(Sorex cinereus)* were found in the stomach of this specimen. The owl was in a very fat and apparently healthy condition.

EDGAR T. JONES

6115 141st Street
Edmonton, Alberta

Some Ornithological Records for Wood Buffalo Park and the Mackenzie District, N.W.T.

In the course of a plane journey from Edmonton to Aklavik made in the spring of 1955, as part of an ornithological investigation to Liverpool Bay, N.W.T., supported by a research grant from the Banting Fund administered by the Arctic Institute of North America, I was delayed for a few days at Fort Smith and again at Norman Wells. A few of my ornithological observations at these localities seem worthy of permanent record. Three of the four reports appear to furnish northernmost distributional records while the fourth is noteworthy because of apparent scarcity of the bird in the region.

Upland Plover *(Bartramia longicauda)*. A pair was seen a few miles from the Hay Camp, Wood Buffalo Park, on May 25. Soper (The Birds of Wood Buffalo Park and Vicinity, Northern Alberta and District of Mackenzie, N.W.T., Canada. Trans. Royal Can. Inst. 24: 19-100. 1942) did not encounter this species during two years' residence in the park and quotes two specimens collected by Preble in 1901 near Fort Smith as the only evidence of its occurrence in the area. Prof. W. Rowan has informed me that he saw at least one Upland Plover in Wood Buffalo Park in 1925.

Magnolia Warbler *(Dendroica magnolia)*. Three males in song were seen in quite a small area near Norman Wells on June 2. Preble (North American Fauna, No. 27, 1908) states that he did not encounter this species farther north than Fort Simpson but quotes an arrival date for Fort Franklin from Richardson. Fort Franklin thus appears to be the most northern point from which the species has been recorded in Western Canada. The few ornithological publications on the area made since Preble's report do not alter this statement. Norman Wells is approximately 30 miles farther north than Fort Franklin but almost certainly does not present the northernmost limit of distribution of this warbler because country of similar vegetation and climate extends much farther northwards along the Mackenzie River.

Nevada Cowbird *(Molothrus ater)*. A male was seen at Norman Wells on May 31 but not on subsequent days up to June 4, when I left the locality. Preble *(op. cit.)* gives Fort Simpson, over 300 miles south of Norman Wells as the northernmost locality from which this species has been recorded. It has not been recorded beyond this point, in publications by later observers in the area.

Starling *(Sturnus vulgaris)*. This species only became common in the Edmonton district of Alberta during the late 1940's. It was observed by Dr. W. Stevens, Superintendent of Game, Mackenzie District, at Fort Smith in 1954, and earlier in 1954 a dead Starling was found west of Fort Smith (Fuller, W. A., Can. Field Nat. 69: 27. 1955). On May 25, I saw both members of a pair repeatedly enter a hole in a poplar at the Hay Camp, Wood Buffalo Park. Nesting or attempted nesting seems highly probable. This observation is the first to suggest breeding of the species in Wood Buffalo Park.

E. O. HÖHN

Department of Physiology
University of Alberta
Edmonton, Alberta

REVIEWS

Prairie Ducks

By LYLE K. SOWLS. Harrisburg, Pa., Stackpole Co., 1955. 193 p., illus. $4.75.

The publication of Sowls' book on the waterfowl of the great central region of North America adds another valuable contribution to the books on American waterfowl. There are now three titles by the Wildlife Management Institute that should be in the library of everyone interested in waterfowl, be the biologist, sportsman or naturalist. Each book does an admirable job in its own special field. Kortright's *Ducks, Geese and Swans* of North America provides the identification manual and general information; Hochbaum's *Canvasback on a Prairie March* is the intimate story of one species, and now the book under review opens up an entirely new field of knowledge of waterfowl behavior.

This is at the same time a research publication and a well and simply written account of the most important aspects in the lives of the pond ducks of the great 'duck factory' region of the continent. Step by step the author treats the events of the summer life of the birds he studied for five years: the migration, the homing tendency, what constitutes nesting terrain, the factors that influence the success of the nesting season, the behavior of the ducks during the nesting season, causes of loss to the parent birds and their young, and the behavior of the birds as the southward flight and the shooting season move in upon them. Each of these is the subject of at least one chapter.

To those already well informed in the general subject of waterfowl biology, one of the most interesting parts of the present book will be the studies of homing. Sowls has shown that most, if not all, surviving hens of pintail, gadwall and shoveller return to nest in the same meadow, year after year. For blue-winged teal this is not true. He has shown also that a large proportion of the young return to nest in the region of their origin.

Here then we have a documentation of what Hochbaum has referred to as the essential conservatism of waterfowl populations. This explains the ease with which a local population may be shot out. Further it offers reason for the successful establishment of local populations as a result of local effort.

The extent of renesting following destruction of the first nest is made known for the first time. All species studied were more or less capable of renesting, but the pintail was the most persistent and the blue-winged teal the least. The proportion of nest losses compensated by renesting has yet to be established. But the facts made known by Sowls help explain the success the pintail, mallard and shoveller often evince in bringing off broods despite unfavorable circumstances in the early part of the season. They reveal the blue-winged teal as a highly vulnerable species.

Of particular point, in view of the popularity of widespread campaigns against crows and magpies on the Prairie Provinces, is the statement that "in many marshes there are several predators competing for duck nests. When one predator is reduced, the damage from another one is increased. Unless waterfowl predator control can be complete and exhaustive, it seems advisable to consider with extreme caution the partial destruction of predators."

This book not only makes an important contribution to the knowledge of the pond ducks but it points up many fruitful avenues for further research.

The production job is well done. Illustrations are numerous and the many pen-and-ink sketches by Hochbaum are particularly attractive.

I. McT. COWAN

Pheasants in North America

Edited by DURWARD L. ALLEN. Colored front. and drawings by Bob Hines. Harrisburg, Pa., Stackpole Co., 1956. 490 p., 82 plates. $7.50.

Durward Allen and his 19 co-workers have put together a most readable and authoritative treatise on the management of the ringneck pheasant in North America. The general pattern is regional, with one or more authorities on this bird and its management, contributing in detail on the important facts surrounding the lives of pheasants in the region of his acquaintance. Six ecological regions are recognized and treated separately. They cover the pheasant range from Canada to Mexico and coast to coast.

This method of treatment makes some repetition almost inevitable. In this instance however, though some more of it might have

been omitted, the repetition often serves to emphasize the range of adaptation the pheasant has been able to achieve. It serves also to emphasize the continent-wide nature of the great decline of the 1940's. The trial and error involved in finding the place of pen-reared birds in the overall picture of pheasant management again becomes more forceful by repetition. Apparently almost each State has experimented in its own region and come up with the same answer.

The increasing use of "put and take" shooting as a private, commercial venture is dealt with in detail; the variations on this theme are worth careful study by game commissions faced with this development.

Dr. Allen has attempted to integrate the broad field of pheasant management by adding a concluding chapter of his own writing. This is a very useful summary of the management outlook and will do much to bring into focus the ideas of all those interested in the pheasant. Not only does he review the present situation and concentrate on the most productive management techniques and attitudes, but he emphasizes the most urgent research needs. When he states that "the greatest present need is to expand basic work in the fields of nutrition, bioclimatics, and physiology," this reviewer is in most enthusiastic agreement.

The opening chapter, "Pheasants and Pheasant Populations" by Fred Dale, is the other integrative chapter of the book. It is written to give the interested sportsman the significant facts of pheasant biology in concise easily understood form. It impresses me as a job well done.

Somewhere in the book I would like to have seen an analysis of the significant features of the decline of the 1940's. But perhaps this can best be done in a more technical article.

This is a book on ring pheasant management. It does not deal with this species of pheasant as a bird, though all life history pertinent to management is fully treated, nor does it deal with pheasants, other than ringnecks, that have been liberated in North America from time to time.

It is a worthwhile addition to the library of sportsman, game administrator and biologist alike, and a credit to its authors and publisher.

I. McT. COWAN

Upland Trails

By DAN MCCOWAN. Toronto, Macmillan Company of Canada, 1955. 28 photographic illustrations, 156 p. $3.25.

Dan McCowan's many friends will find his sixth book a welcome addition to the five which have preceded it.

As in previous works, much of the material contained in the short stories which form the twenty-nine chapters concerns his beloved Rockies and other parts of Canada. Most of these stories deal with wildlife, natural history and animal behavior but their range is wide. As usual, personal observations and historical references do much to increase the interest.

He writes of Rocky Mountain place names, bird and mammal play and other behavior, trees and smaller plants, hailstones and even the mechanics of the aurora borealis.

His long residence in Banff and his acquaintance with many problems of National Parks lead him to several references to proper public conduct in the presence of wildlife. Careful attention to his suggestions will do much to increase public safety and public enjoyment of wildlife in these great natural areas.

Students of detailed natural history will find many of the subjects treated in a light and superficial manner. This implies no criticism since the book was written to be read and enjoyed by those seeking pleasant entertainment and interesting anecdotes rather than detailed scientific information.

The type is large and clear, the text free from typographical errors and pleasant to read.

V. E. F. SOLMAN

Travels and Traditions of Waterfowl

By A. ALBERT HOCHBAUM. Minneapolis, The University of Minnesota Press and Toronto, Thomas Allen Ltd., 1956. 301 p., $5.50.

This new book from the pen of the director of the Delta Waterfowl Research Station is a significant contribution to the rapidly growing literature on animal behavior. It contains much information of importance to workers in wildlife management and ornithology; but it should also be of great interest to naturalists and sportsmen. Authoritative semipopular books on any phase of natural history in Canada are few enough to make the present volume doubly important.

The author's thesis is the role of tradition, that is, information transmitted by example rather than genetically, in migration and other movements of waterfowl (Anatidae). He presents convincing evidence of the degree to which waterfowl behavior is governed by tradition, and the information, new and old, brought together is vital to several phases of waterfowl management. All degrees of traditional movement are considered, starting with the more or less fixed paths over the Delta marsh.

A good deal of solid presentation of background information is needed to put the reader in a position to follow the author's arguments; and some of the early chapters provide rather heavy reading; but the later chapters form an excellent and skillfully presented capitulation. An excellent bibliography of close to 500 references is included and key references are noted for certain subjects. There is also an appendix of bird names and an adequate index.

In a few places the complexity of the subject seems to have affected the author's style to the detriment of readability. Some rather ponderous philosophical discussions of time, space and memory, not very pertinent to the theme of the book, might well have been deleted. The chapter on the dimensions of travel is made difficult to read mainly by the loose use of the word "relative" in various connotations; adoption of the concepts of *angular* size, movement, and velocity would have clarified the discussion.

Chapter 5, on the aerial environments, is perhaps hardly up to the level of the others. It is unfortunate that Poole's odd, inverted definition of wing loading is given instead of that universally used in aircraft aerodynamics. The author seems to infer that most birds are highly stable, whereas they are inherently unstable to a degree unthinkable in aircraft, which increases maneuverability and reduces landing speed. It is hard to imagine anything more violently unstable than a Mallard or Black Duck dropping into a pond. That a bird can maintain control under such conditions is a tribute to its rapid reactions and delicate balance system. The loons are not excessively unstable; they simply have too high a wing loading and too inefficient a wing to fly slowly. The alula and emarginated primaries are high-lift rather than stability devices — a confusion that has been made before.

In emphasizing his arguments the author makes a few generalizations that may not be wholly justified. How general, for example, is the ability of a duckling to recognize its mother? I doubt if this is true of Old Squaws, in which the broods frequently get mixed in all proportions. Although the mechanism of migration and navigation by visual cues and familiar landmarks that the author proposes may be largely true for ducks, it seems to me that we have a long way to go before it can be safely applied to all groups of birds. For example, the young European Cuckoo seems to migrate without adult guidance. How can the directional flights of night migrants and the ocean passages of penguins under overcast skies be explained in terms of orientation by the sun or a down-wind drift?

These are minor points, however, and the book makes an important contribution to our understanding of bird behavior, migration and distribution. The volume is well bound, and printed on substantial paper. It is delightfully illustrated with pen sketches by the author — a pleasant relief from the glossy photographs that make so many modern books look like seed catalogues.

D. B. O. SAVILE

The Geography, Birds, and Mammals of the Perry River Region

By HAROLD C. HANSON, PAUL QUENEAU, and PETER SCOTT. The Arctic Institute of North America, Spec. Pub. No. 3, 1956. 34 fig., 96 p. ($2.00 to nonmembers of the Arctic Institute; $1.00 to members).

Angus Gavin's discovery in 1938 of the breeding grounds of Ross's Goose in the remote Perry River, N.W.T., barrens, and his subsequent published reports of relatively rich bird and mammal faunas, inspired the authors to journey there in 1949 and spend the period June 6 to August 2 gathering data and specimens. Queneau did the mapping, geological, and meteorological studies; Hanson supervised the general biological program; and Hanson and Scott collaborated on the bird studies.

The area was so poorly known that maps of it were very sketchy. Perry River was found to flow approximately due north, not northeast; to drain from the east side of MacAlpine Lake instead of its west side; and its mouth to be some fifteen miles farther west than was shown on then-existing maps, placing it in Mackenzie instead of Keewatin.

The report contains data on the cartography, physical geology, weather, ice and snow conditions, the Eskimo, transportation problems, and vegetation.

The section on birds (p. 29-81) gives much interesting information on the forty-seven avian species and subspecies that the authors encountered. The avifauna, aside from its Holarctic and Nearctic elements, shows affinities with western populations. The accounts of the waterfowl are most full. Ross's Goose, *Chen rossii,* never previously studied by scientists on its nesting grounds, received most attention and 12 pages of the report are devoted to it. Data are given on its downy plumage which was found to be definitey dichromatic, local distribution, productivity, nesting habits, populations, behavior, food habits, and band recoveries. Specimens are listed and taxonomic comments are made on them as necessary. In addition, for a number of species there are data on weights, sex ratios, and parasites.

Mammal studies (p. 82-89) were secondary to the investigations of the bird life. The section contains information on *Lepus arcticus, Citellus parryii, Lemmus trimucronatus, Discrostonyx groenlandicus, Clethrionomys rutilus,* and *Rangifer arcticus.*

Two appendices, with brief comments on rock specimens and a few fishes and insects, and a list of literature references bring this commendable report to a close. It is well printed on good paper and is superbly edited.

W. EARL GODFREY

The Marine and Fresh-Water Plankton

By CHARLES C. DAVIS. East Lansing, Michigan State University Press, 1955. 681 fig., 562 p. $10.00.

This carefully prepared work brings together a wealth of information on marine and fresh-water plankton in a most interesting manner.

The material presented is included in nine chapters. The first two, comprising introduction, special adaptations to planktonic existence and general cycle of production in aquatic environments, deal with general features of plankton life history and the chemical and physical nature of the environment.

Following these general discussions of environment comes a most interesting chapter on phytoplankton, with a long and carefully documented discussion of regional and seasonal distribution, the production of 'blooms' of phytoplankton and their deleterious and sometimes dangerous effects.

The next two chapters deal with phytoplankton-zooplankton relationship and problems of distribution. Distribution is discussed in relation to season, water movements, diurnal and other vertical migrations, movement of larvae and speed of movement. These discussions are particularly well documented and, although the reasons for some movements are not yet known, various theories advanced in explanation are well set forth for consideration.

A short chapter on geographic and seasonal variation in structure of zooplankton is followed by a larger discussion of plankton organisms as feeders on still smaller forms of life and as a food source for larger animals, up to and including whalebone (baleen) whales.

In the next 138 pages, constituting chapter 9, the author discusses in some detail the life history, structure, reproduction and habits of the various groups of plants and animals that compose marine and fresh-water plankton. Each of the three phytoplankton and 17 zooplankton phyla or orders dealt with has the descriptive text accompanied by a useful analytical key to the more common genera. The descriptions and keys are supplemented by all but 48 of the 681 figures which serve as effective illustrations for the many forms discussed.

A fifteen page glossary defines technical terms not explained in the text and a bibliography occupying twenty-four pages gives a good review of current and past literature on the subject. A twenty-one-page index to both subjects and authors aids in locating reference material.

A Canadian reviewer must point out the absence of Canadian examples and authors from the text, but in view of the relativey small literature on plankton by Canadian authors, this ommission does not reduce the value of the book significantly.

The book fills a long-felt need for a text and reference work for college courses and general studies concerned with plankton. Treating as it does in a general way both marine and fresh-water forms, it will bring home to all the relationships and dissimilarities of these two media and of their plankton populations.

The book has been carefully produced with easily-read type and clear illustrations.

V. E. F. SOLMAN

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DISTRIBUTION OF MARTEN AND FISHER IN NORTH AMERICA

EDWIN M. HAGMEIER

University of New Brunswick, Fredericton, New Brunswick

Received for publication September 4, 1956

The following is a summary of what is known of the distribution of marten *(Martes americana)* and fisher *(Martes pennanti)* in North America. Since it is based on a survey of the available literature and an examination of a fairly large series of museum specimens, it deals with past as well as present ranges.

The study forms part of a thesis directed by Dr. I. McT. Cowan, and presented to the University of British Columbia. Assistance, given by many people, is gratefully acknowledged. The following is a partial list of those who have helped: Doctors J. W. Aldrich, S. B. Benson, L. Butler, W. A. Clemens, E. L. Cockrum, F. W. Fay, E. R. Hall, W. J. Hamilton Jr., N. Preble, L. Russell, H. Setzer, G. Swanson, and Messrs. D. Benson, A. Cameron, R. Denney, C. Guiget, F. C. Kleinschnitz, F. Merner, J. A. Munro, F. Newby, D. Pimlott, R. W. Sutton, J. S. Tener, B. S. Wright, and Miss H. Silver. The following have provided specimens for examination: Doctors Benson, W. Burt, Cowan, J. D. Doutt, Hall, D. Johnson, H. Tate, P. L. Wright, L. E. Yeager, and Messrs. J. Bryant, A. Cameron, W. Cottle, R. Y. Edwards, D. Flook, C. Lensink, K. Racey, R. Webb, and Miss Viola Schantz. A great many workers, not named here, have been generous in their loans and gifts of papers and books and in other ways. The study has been financed in part with funds provided by the University of British Columbia, the British Columbia Sugar Company and the National Research Council of Canada. Mrs. Elizabeth Hagmeier has devoted time to typing and proofreading.

The distribution of marten in North America is governed by the distribution of the northern evergreen forest (Seton 1925-28, Grinnell, Dixon and Linsdale 1937, Bailey 1936, Dalquest 1948, Merriam 1886, Merriam 1882 and 1884, de Vos 1952). Lensink (1953) concluded that marten distribution in Alaska is coincident with the distribution of white and black spruce, "which is apparently the critical element in their habitat." Edwards (1950) wrote that those coniferous forests of highest market value supported the greatest number of marten. Anthony (1917) believed, however, that "...it does not appear to be particularly attached to coniferous woods, living in them simply because such forests prevail to a great extent in the geographical areas it inhabits." The work of Ponomarev (1944) supports this view. He said that Eurasian marten had their distributions controlled chiefly by the presence or absence of low temperatures (20°C. and less). Most workers name the humid upper Transition, the Canadian and the Hudsonian life zones as those inhabited by marten (Rhoads 1903, Cary 1917, Grinnell and Storer 1924, Skinner 1927, Williams 1930, Bailey 1936, Grinnell, Dixon and Linsdale 1937, Hall 1946, Rust 1946, Dalquest 1948, Yeager, Denney and Hammit 1949, de Vos and Guenther 1952, Durrant 1952, and Sumner and Dixon 1953). Marten have been found outside the evergreen type forest. While de Vos (1952) and most writers consider them scarce or absent in hardwoods, a few report them common there (Emmons 1840, Adams 1873, Rhoads 1903, Allen 1904, de Vos 1952). This relationship also holds, it seems in Eurasia, since Jurgenson (1939) wrote that *Martes martes* prefer a mixed deciduous-coniferous forest to any other. In mountainous regions, marten have been known to frequent talus slides (Turner 1886, Grinnell and Storer 1924, Clarke 1940, Hayward 1952, and Marshall 1951), and tundra and meadows (Turner 1886, Cary 1911 and Clarke 1944). One was taken in the sagebrush vegetation of the upper Sonoran Zone, 2000 feet below forest in the Sierra Nevadas (Jones 1955). Marten

The Canadian Field-Naturalist for July-September 1956 (Can. Field Nat. 70: 101-148. 1956) was issued May 8, 1957.



Fig. 1. Marten distribution

have decreased in numbers in the past several centuries (Henderson and Craig 1932, Seton 1925-28, Allen 1942, Yeager 1950, Minville 1946, Innis 1927, Anon. 1927-50, Squires 1946, Butler 1950).

The distribution of fisher is similar to but not identical with that of marten. Their northern limit is 10° south of that of marten, and, while they extend as far south in the Pacific mountains, their range is more restricted in the Rocky Mountains, and more extended in the eastern United States. While marten occur on coastal islands, fisher are absent. Part of the explanation for the fishers' distinctive range may lie in their environmental requirements. Merriam (1882-84, 1886) reported that they fed on beech nuts, and Rhoads (1903) said that many were caught in the beech woods of Pennsylvania. Shorger (1942) wrote that while they were never as common as marten in the Lake states, they were far more common in the hardwood timber. De Vos (1951) said that they are present in second-growth forest where marten are absent. The same author also stated (1952) that while they prefer heavy timber, they are frequently seen in open second-growth stands and occasionally in areas recently burnt over. In Ontario they are not strict in their habitat requirements, and occur in coniferous, mixed, and maple — yellow birch forests. Mason (1924) and Martin (1950) reported that they ranged over burnt areas of willow, birch and aspen. Barger (1951) said they live through the hardwoods of Wisconsin. In the area about Great Slave Lake, fisher often occurred in the grassy prairies at the mouth of the Slave



Fig. 2. Fisher distribution

River (Ross 1861). Edwards (1950) reported them in alpine grasslands. Fisher are believed to stay at lower altitudes than marten. Rhoads (1903) said they prefer low wet grounds and the banks of streams, whereas marten stay on the hills. In the mountainous country of the west fisher are reported to live in the lowlands with marten, while only marten live in the higher country (Rand 1944, Edwards 1950, Webb 1952). The life zones in which fisher live are said to be the humid Transition and Canadian zones (Rhoads 1903, Grinnell, Dixon and Linsdale 1937, Bailey 1936, Rust 1946, Dalquest 1948). Rhoads (1903) wrote that in Pennsylvania they also occurred in the Hudsonian zone. Fisher, like marten, have decreased in the last century (Seton 1925-28, Allen 1942, Minville 1946, Innis 1927, Anon. 1927-50, Henderson and Craig 1932); however, recent local increases have been reported (Hamilton and Cook 1955, Coulter 1952). Fisher are known only from North America. Poland (1892) mistakenly stated, however, that "... a few are still found in South America, and skins from these parts having only hair."

Figures 1 and 2 map the distributions of marten and fisher as they likely occurred when the white man came to the continent. The present limits of both species, when compared to the distributions mapped, are now much reduced, especially in the south. The outline of the original limits has been freely drawn, and is based in part on information obtained from vegetation maps. Other distribution maps of these species have been prepared by the following: Seton 1909, Cary 1911, Cory 1912, Grinnell and Dixon

1926, Seton 1925-28, Anderson 1934, Brouilette 1934, Bailey 1936, Grinnell, Dixon and Linsdale 1937, Melven 1938, Dufresne 1942, Hamilton 1943, Hall 1946 and 1954, Twining and Hensley 1947, Dalquest 1948, Burt 1948, de Vos 1952, Durrant 1952, Webb 1952, Lyon 1936, Bandy 1952, Macleod 1950, Edwards 1950, and Hamilton and Cook 1955. A complete list of the literature used in the preparation of Figures 1 and 2 may be found in the thesis from which this paper has been prepared.

ALASKA

MARTEN: All of forested Alaska, as far west as Norton Sound and Kotzebue Sound (Nelson and True 1887) and nearly to the mouth of the Yukon River (Dice 1921) and as far north as the head of the Nunatog River at latitude 68° (Nelson and True 1887) and Anaktuvak Pass in the Brooks Range (Rausch 1950 and 1951); the Kenai Peninsula and the Panhandle; the following at least of the Alexander Archipeligo: Admiralty Island (Swarth 1911, Dufresne 1946, and specimens examined), Etolin Island (specimens examined), Kodiak Island (Nelson and True 1887), Kuiu Island (Swarth 1911, Dufresne 1946, and specimens examined), Kupreanof Island (Dufresne 1942 and 1946 and specimens examined) and Revillagigedo Island (Dufresne 1946 and C. Lensink letter). Marten were introduced into Prince of Wales and Chichagof islands in 1934 (Dufresne 1946). Localities not mapped include: Savioyok Valley, Brooks Range (Rausch 1951); Bering Sea, coast of Alaska (Elliot 1905); Salcha (U.S. Fish and Wildlife Service file).

FISHER: Coues (1877) said that he had examined specimens from Alaska, but did not give a specific locality of capture. Remarking on this, Osgood in 1900 reported that "no specimens are at hand to corroborate this record, but there is little doubt that it occurs along the upper Yukon, as it is known from similar latitudes to the eastward." Turner (1886) wrote that they occur "sparingly in the upper Yukon valley; rather more abundantly in the heavier timbered regions to the south," but nowhere did he explicitly refer the area to Alaska. Macleod (1950) recorded them from the lower Iskut region of British Columbia, very near the Alaskan Border, and they may possibly occur in the southern part of the adjacent panhandle.

ALBERTA

MARTEN: Probably through all of the forested part of the province, from the Rocky Mountains east to Waterton Lakes National Park (Banfield 1947) and Rocky Mountain House (specimens examined); absent from the grasslands, occurring at least as far south as Whitehead, Smith Landing, Athabaska River (specimens examined) and Lac la Biche (Seton 1911), and probably further. Present through the remainder of the province; more common formerly than now (Seton 1911, Soper 1942, 1947 and 1948 and Rand 1948). Chief collecting points have been Forts Chipwyan, Fitzgerald and Vermilion, and Upper Hay River (L. Butler, letter).

FISHER: All of forested Alberta, at least as far south in the west as Prairie Creek near Rocky Mountain House (specimens examined) and in the east as far as the Athabaska River (Preble 1908). Rand (1944a) said they inhabit two-fifths of the north and west of the province. L. Butler (letter) writes that Alberta has the least fisher of any of the three prairie provinces. Its catch has come chiefly from Fort Vermilion, Little Red River and Sturgeon Lake. Rand (1948a) said they are "now scarce in, or unreported from, many areas."

ARKANSAS

FISHER: Brown (1908) reported a Pleistocene recovery of *Martes pennanti* from Conard Fissure in Newton County. Hall (1936) believed these may be referable to *M. diluviania* (a small extinct fisher). No recent records are known.

BRITISH COLUMBIA

MARTEN: Occur through all of the following biotic areas of Munro and Cowan (1947): Cariboo Parklands, Columbia Forest, Subalpine Forest, Boreal Forest, Peace River Parklands, Coast Forest, Queen Charlotte Island, and Vancouver Island (many sources and specimens examined); are present on both Graham and Moresby islands of the Queen Charlotte group (specimens examined). Macleod (1950) said they have been trapped on Pitt, McCauley and Hawksbury islands, and suggested that they occur on still others. C. Guiget says they have been reported from Hunter Island. Relatively large numbers are still trapped every year. An unmapped record is Dove Creek Trail, Forbidden Plateau, Vancouver Island (Hardy 1954).

FISHER: Still common throughout most of the forested part of the province; occur in

the following Biotic Areas of Munro and Cowan (1947): Coast Forest, north to the Iskut River and south to the region about Namu and River Inlet (Macleod 1950); apparently absent south of this area except for the region about Manning Park (specimens examined, Carl Guiget and Hardy 1952, Goldman 1935, Rhoads 1898, Edwards 1950); Subalpine Forest, at least as far north as Ware on the Finlay River (Bandy 1952) and as far south as Kamloops and Salmon Arm (specimens examined); Cariboo Parklands (Webb 1953 and specimens examined); the northern parts of the Columbia and Dry Forests, apparently no farther south than about Invermere (Bandy 1952); Boreal Forest, east to the Alberta boundary (Edwards 1950, Rand 1944c, Quick 1953, Baker 1951, specimens examined and other sources), and west to the Lower Post area (Rand 1944c, Edwards 1950); also present in the area about Dease Lake and Anvil Mountain (Edwards 1950); apparently absent northwest of a line connecting the Lower Iskut River, Dease Lake and Lower Post; occur in the Peace River Parklands, including the Peace River area (Cowan 1939, Edwards 1950) and the area about Fort Nelson (Quick 1953, Edwards 1950, and specimens examined); do not seem to occur in the Parklands east of Fort Nelson; are absent from any of the islands along the coast. A specimen is listed in the U.S. Fish and Wildlife Service File as having been taken from Graham Island, but J. A. Munro, the collector, writes that the listing must be attributed to clerical error. Two unmapped records for the province are New Caledonia (Macfarlane 1905) and Buckingham area (Rand 1944a).

CALIFORNIA

MARTEN: The forested parts of the Klamath Mountains and Coast Mountains as far south as Sonoma County, and the Sierra Nevadas as far south as Tulare County (Grinnell 1933, Grinnell, Dixon and Linsdale 1937, Twining and Hensley 1947). One specimen from San Joseph Island, Lower California, (U.S. National Museum No. 32033) is identified as a marten, but is likely referable to *Bassariscus*. Marten were trapped in the winter of 1948-1949. Localities not mapped include Rush Creek and Bear Creek (Kellogg 1916).

FISHER: The mountainous part of the state, from the Oregon boundary south in the Klamath and Coast Ranges to the region about Lakeport, Mendocino County and Lake County; also recorded from Main County; south in the Sierra Nevadas to Greenhorn Mountain, Kern County (Summer and Dixon 1953, Grinnell, Dixon and Linsdale 1937). According to most authors, their numbers are now much reduced. Records not mapped include Fort Crock, Cahlo, Big Creek, Mariposa County and Atwell's Mill (specimens examined).

COLORADO

MARTEN: Everywhere in the higher mountains above 9,500 feet (Williams 1947, Remington 1950, Yeager, Denney and Hammit 1949) from the northern to the southern boundaries of the state and as far east as western Arapahoe County (Yeager 1950) and western Huerjane County (R. Denney, letter). F. C. Kleinschnitz (letter) believes marten to be found in the following counties beyond those mapped: Alamosa, Archuleta, Chaffee, Conefos, Custer, Della, Delores, Fremont, Gilpin, Hinsdale, Huerjano, Lake, La Plata, Mesa, Moffat, Ouray, Pitkin, Rio Grande, Saguache, San Miguel, and Teller. Marten were being trapped in the winter of 1948-1949 (Yeager 1950). Localities not mapped are East Spanish peak and Bennett's Well (Cary 1911), and Camp Hale (Remington 1950).

FISHER: "Said to be more or less common in Park County..." (Allen 1874). Commenting on this, Cary (1911) wrote "I have made careful inquiry of old hunters and trappers throughout... northern Colorado... and have yet to meet one who... has even heard of the animal within the state... . It seems probable that Allen's record is based upon erroneous information." Warren (1942) said that there had been rumors of their occurrence, but concluded that they had never inhabited the state. Yeager, Denney and Hammit (1949) referred to them as "rare; if present at all in the original fauna, has been extirpated... ." R. Denney (letter) says that two were imported from British Columbia five years ago, and are now living in captivity. I know of no other records.

CONNECTICUT

MARTEN: Linsley (1842) listed marten for the state but Goodwin (1935) found no authentic records. He believed that they may once have occurred on the mountains of the northwestern and possibly the northeastern parts of the state. Two specimens from the American Museum of Natural History (41340 and 41335) collected in Greenwich are labeled

"*M. foina*" and "*M. americana*," and to the second is appended the statement "This may be an introduced species." Examination of these has led me to conclude that the first specimen is referable to *M. foina* and the second to *M. zibellina*, and that neither represent the native fauna.

FISHER: Linsley (1842) listed the fisher. Goodwin (1935) reported that they have "supposedly been extirpated for many years; it is not impossible, however, that a few individuals may still survive in the wilderness of the northwestern section of the state or in the highlands of the northeast." He said that 124 fisher were trapped in 1924.

DISTRICT OF COLUMBIA

MARTEN: Captain John Smith in 1607-1608 (after Mansueti 1950) recorded 'martens' from the district. McAtee (1918) said that "according to Wm. Palmer there is a fairly certain record as late as about 1880." Bailey (1926) and Mansueti both concluded that marten once occurred in the area.

IDAHO

MARTEN: The forested mountains of the state, as far south as Ada, Elmore, Blaine and Fremont counties (Baird 1857 and 1859, Suckley and Gibbs 1860, and specimens examined). The vegetation map of Davis (1939) suggests that they may occur in Caribou, Bonneville and Bear Lake counties. They were still being taken in the winter of 1948-1949 (Yeager 1950). An unmapped locality is Kanisku region (Rust 1946).

FISHER: The mountainous part of the state, including the Selkirk, Bitterroot and Salmon River ranges, originally as far south as Sawtooth (specimens examined), Ketchum and Alturas Lake, all in Blaine County (Davis 1939); now probably restricted to the northern and central parts of the state, and very scarce (Davis 1939, Rust 1946).

ILLINOIS

MARTEN: Kennicott (1855 and 1859) said they were formerly present in Cook County, and Sanborn (1925) believed they once occurred about the Chicago region. Hahn (1909) and Cory (1912) reported that a skeleton of a marten was held by the Chicago Academy of Sciences and that it was said to have been collected in the northern part of the state many years before. Shorger (1942) concluded that they once occurred in the strip of pine timber along the shore of Lake Michigan. Mohr (1943) wrote that recent reports (U.S. Forest Service 1937) have listed marten as occurring in the state. According to Mohr these reports are incorrect and the animal has been extinct for a century.

FISHER: Kennicott (1855) reported fisher from Cook County, saying they used to be common in the timber along Lake Michigan. The same author in 1859 said they occurred in the woods of the northern part of the state. Sanborn (1925) said they have occurred within historic times about the Chicago region. Forbes, in 1912, reported they "have long been extinct in this state". A record from southern Indiana (see below) suggests that fisher may have once occurred in southern Illinois.

INDIANA

MARTEN: Hahn (1909) considered them a "hypothetical intruder." Lyon (1936) believed that if they occurred in Illinois (see above) they likely occurred in Indiana. Shorger (1942) concluded that they formerly penetrated into the strip of pine timber that ran along the shore of Lake Michigan.

FISHER: Formerly, it seems, through most or all of the state. Plummer (1844) wrote that they had not been seen since 1820, but that prior to that time they were "not uncommon." Lyon (1936) said that the last specimen was taken in 1859. The same author (1933) considered them a wanderer from the north, and not a normal inhabitant. Records are known from the following counties: Porter (Rand and Rand 1951), Hamilton (Lyon 1936), Wayne (Plummer 1844, Hahn 1909), Posey (Lyon 1936, Hahn 1909) and Ohio (Kirkpatrick and Conway 1948).

IOWA

MARTEN: Scott (1937) cited papers by Goding and Osborn as listing marten for the state, but considered these records doubtful. He concluded that they "may have entered northeastern Iowa as a straggler many years ago . . ."

FISHER: Goding (after Scott 1937) considered the species "rare" and the same author cited Spurrell as reporting that tracks were seen in Calhoun County and a few skins traded north of Sac County in the 1850's. Scott considered these records open to question, but believed the fisher may once have been present.

KANSAS

MARTEN: E. L. Cockrum (letter, citing Cockrum 1952) wrote that Mead (1899) said "martens were rare," and that for this reason Hibbard (1933) listed them as a former inhabitant. He concludes that marten have not occurred in the state within historic time.

MAINE

MARTEN: Occur throughout the mountainous northern part of the state. Seton (1925-28) wrote that they are rarely seen now in the southern parts. They are reported to have occurred as far south as Muddy River (Topsham) about 1915, and New Gloucester 100 years ago, and are known from the shell heaps on Goose Island (Norton 1930). Coues (1877), Allen (1876), and Anderson and Sclater (1881 and 1891) reported them from as far south as central Oxford County. The last specimen was taken in 1936 (Yeager 1950).

FISHER: In all but the southern part of the state, at least as far south as Brownfield (Coulter 1952), Lincoln (Rhoads 1898) and extreme southern Aroostook County (Hardy 1910). Coulter said "it is now common north and west of a general line from Brownfield to Rumford, Stron, Bingham, Guilford, and Katahdin Iron Works, thence north to Mt. Katahdin, Portage, and St. John Plantation. [Also found in] ... two districts in northwestern Franklin County close to the Canadian border." Coulter added that "it is now common ... [whereas] ten years ago it was reported as rare"

MANITOBA

MARTEN: Originally all of the province, except perhaps the extreme southwest portion and the barrens about Hudson Bay; now very rare south of latitude 53°N (Melven 1938). The most southerly records are Aweme (Criddle 1929), Pembina Mountains (Seton 1925-28), and Riding Mountain National Park, where they became extinct about 1915 (Soper 1953). One was captured on the poplar bluffs near the Delta Research Station in the winter of 1951-52 (J. Bryant, and letter of R. W. Sutton). Marten were being trapped in the winter of 1948-1949 (Yeager 1950). The chief collecting points are Nelson House, Lac du Brochet and Shamatawa (L. Butler, letter).

FISHER: Originally all of Manitoba south of a line connecting Stony Lake (Melven 1938), Churchill River (L. Butler, letter), and York Factory (Preble 1902), and north and east of Riding Mountain (Greene 1932) and Assiniboine (Seton 1925-28). "Are now found chiefly between the Ontario border and Lake Winnipegosis, with a few further north along the Churchill River. The province has the highest catch of any of the Prairie Provinces, the chief collecting points being Little Grand Rapids, Berens River and Norway House" L. Butler, letter). They were taken in the following sections in 1952: Wabowden Lake, Sherridon Lake, Norway House, Oxford House, Island Lake, Pukatawagan, God's Lake, and Cross Lake (Malaher 1952). J. Bryant has told me that they have increased in numbers and extended their range in the past few years.

MARYLAND

MARTEN: Scharf (1882) said that "marten occurred in western Maryland." Mansueti (1950) wrote that they have been completely extirpated from the state for at least 70 years. "Its distribution probably was not widespread." J. W. Aldrich (letter) reports that there appear to be no definite records for the state.

FISHER: Although no positive records exist, Mansueti (1950) believed that they probably occurred in Garrett County and other portions of western Maryland more than two centuries ago. Poole (1932) recorded a specimen captured in 1921 in Holtwood, Pennsylvania, about twelve miles from the Maryland border.

MASSACHUSETTS

MARTEN: Formerly present in the Berkshire Mountains of Bershire County (Emmons 1840, Allen 1869, Coues 1877, Allen 1904). Hamilton (1943) suggested that they may still occur in the area.

FISHER: Originally, at least, through the Berkshire Hills and Green Mountains of the western part of the state (Emmons 1840, Allen 1869, Allen 1904); according to Allen (1904) extinct at time of writing.

MICHIGAN

MARTEN: Formerly all of the timbered areas of the state as far south as Allegan County; also on Isle Royale, and Sugar Island. None have been taken in twenty-five years and they are now rare or absent. (Burt 1948, Pruitt 1951).

FISHER: Originally all of the state, at least as far south as Wexford, Gratiot, Ingham,

Washtenow and Wayne counties (Burt 1948 and specimens examined). Pruitt (1951) said they have been seen on Sugar Island. Shorger (1942) reported the last specimen trapped in 1930-1931. Burt (1948) considered them very rare or absent. Locality not mapped: Park Siding (Elliot 1907).

MINNESOTA

MARTEN: Northern Minnesota, as far south as Polk County (specimen examined) and Crow Wing County (Swanson, Surber and Roberts 1945); originally common, rare by 1900, and probably now extinct, although still possibly existing in Superior and Chippewa National Forests (Shorger 1942, Swanson, Surber and Roberts 1945, Gunderson and Beer 1953, Stenlund 1955). The last specimen was taken in 1953 in St. Louis County (Stenlund 1955).

FISHER: Occured at one time throughout northeastern half of the state, their southwestern limit being a line connecting eastern Pennington, southern Clearwater, southern Crow Wing and southern Ransey counties (Shorger 1942, Gunderson and Beer 1953, Swanson, Surber and Roberts 1945); formerly numerous, but now rare and restricted to the extreme northern and western portions of the state and are still taken there in small numbers. An unmapped record is Big Bog (Shorger 1942).

MONTANA

MARTEN: Through the Montana and Bitterroot sections of the Northern Rockies, as far east as western Glacier, Telon, Cascade, Lewis and Clark, Jefferson, and Beaverhead counties (Wright 1953, Newby 1955, and specimens examined). Also present in the southwestern part of the state in Madison, Gallatin, Park, Sweetgrass, Stillwater and Carbon counties (U.S. Fish and Wildlife Service File, Newby 1955, and specimens examined). They are still common (Yeager 1950, P.L. Wright, Letter). Newby (1955) has published a detailed distribution map for the state.

FISHER: Only three records are known to me; these are Glacier National Park (Allen 1942), Swan River, south fork, and upper Swift Current River (Bailey and Bailey 1918). Only the first two of these have been mapped. F. E. Newby (letter) says that these records are so unreliable as to be unauthentic. Because they occur in central Idaho and northern Wyoming, it is possible that they occur or occurred throughout much of the Montana section of the Northern Rockies; it is significant however, that there are no records from southeastern British Columbia.

NEBRASKA

MARTEN: Swenk (1908) cited an undated publication of Aughey who reported that they had been taken in the northwestern part of the state, but that they were rare. Swenk considered them extinct at time of writing.

FISHER: Swenk (1908) believed that they likely occured within the state but found no record of their presence.

NEVADA

MARTEN: Reported to occur in the southwest portion where the Sierra Nevadas enter the state, from Mount Rose south to Monument Peak. One specimen is known from Marlette Lake (Hall 1946).

FISHER: "Occurs in the Sierra Nevada of California and may occur in these mountains between Carson City and Reno. Satisfactory evidence of their presence within the state is lacking" (Hall 1946). Grinnell, Dixon and Linsdale (1937) map them as entering Nevada.

NEW BRUNSWICK

MARTEN: Once common throughout all of the province (Chamberlain 1884 and 1892); at present greatly reduced and restricted to the more remote areas (Allen 1942, Morris 1948). No specimens have been taken legally since 1945-46, but they are still found, and the occasional one is taken. There is an unsubstantiated sight record from Taymouth. Specimens not mapped include Lake Edward (Chamberlain 1884 and 1892), between Lake Edward and Salmon Lake (Elliot 1901a and b), and Salmon Lake (Chamberlain).

FISHER: Original range not known, but at present restricted to the central and northern parts of the province (Rand 1944a, Morris 1948). B. S. Wright (letter) says fisher tracks were seen in 1953 in the Burpee Game Reserve (Sunbury County), where a fisher brought from Ontario had been released in 1950. A fisher was taken in 1956 in Charlotte County, and is now held captive in the Provincial Game Farm. Another has been seen near Renous. These records are the most southerly in the province. Chamberlain (1884 and 1892) considered the fisher rare at time of writing, but Wright (letter) says a few are still taken each year.

NEWFOUNLAND (excluding Labrador)

MARTEN: Originally common in all the wooded areas (Reeks 1870 and 1871) but now very scarce (Bangs 1913, Allen 1942). A. Cameron (letter) says they are now rare and confined to the more inaccessible regions. D. H. Pimlott (letter) reports that they have, for the past two years, been reported from the lower Grand Lake and Gambo Lake areas only.

NEW HAMPSHIRE

MARTEN: Found originally in the White Mountains and northward (Allen 1904); very nearly, if not completely, exterminated now (Preble 1942-43). N. Preble (letter) has sent the following information. One specimen is known from the state, this from Coos County in the New England Museum of Natural History (Boston Museum of Science). They were common 100 years ago in the Crawford Notch region of the White Mountains, but are now rare, the last specimen being taken in 1936. Alfred Preble saw an animal on Mount Washington in 1930 that was likely a marten, a fisher, or a ring-tailed cat. A marten was reported at the same place in the spring of 1944. All records from the state are in Coos County except one from Laconia in Belknap County taken between 1931 and 1935 (Helenette Silver, letter, after Jackson 1922). They have recently been reintroduced into the northern part of the state (Monahan 1953).

FISHER: At one time through all of the White Mountains and northward (Allen 1904). Records are known from the extreme northern part of Coos County to southern Cheshire County in the very southern part of the state (specimens examined). Carpenter and Siegler (1945) and Hamilton (1943) said they were still present, and N. Preble (letter) says two were taken in 1936. Helenette Silver (letter) says a specimen was trapped at Warner in 1951, and adds that "I have heard well authenticated rumors of others being taken by trappers who were afraid to turn them over to us as they are fully protected.... It is probable that they are more common than we know." F. H. Fay has told me that he recollects that two young fisher were captured in 1949 or 1950 near Lake Ossipee in the east-central part of the state, and that another was seen on the road at Pasaconaway near North Conway in 1948. An unmapped record is Greenough Trail (Helenette Silver, letter).

NEW JERSEY

MARTEN: "Once abundant in the mountain regions. Now wholly absent from the state. Probably exterminated fifty years ago" (Rhoads 1903). I know of no other records.

FISHER: Abbott wrote in 1868 that "about the mountains in the northern counties a few are still living." In 1889, Nelson reported that a few persisted in the northern part of the state; Rhoads (1903) knew of no record other than Abbott's; he concluded that they had occurred in the northern section in former days.

NEW MEXICO

MARTEN: Present, but by no means common, in the high mountains of the northern part of the state, especially the San Juan and Sagre de Cristo Ranges (Bailey 1931). Records known are from Chama (specimen examined), Taos (Wheeler 1875), Twining, and Truchas Peak (Bailey 1931) and Las Vegas Mountains (Durrant 1952). The last locality named is the most southerly record in North America. Allen (1942) believed they still existed in the state; their present status is unknown to me. An unmapped locality is Twining (Bailey 1931).

NEW YORK

MARTEN: Formerly common in the Adirondacks and possibly the Catskills until 1890 (DeKay 1842, Merriam 1882-1884, and 1886, Mearns 1898, Miller 1899 and 1900) but trapped almost to extinction since then (Seton 1925-1928). The most southerly records are those from the Catskills (Audubon and Bachman 1851-1854, Mearns 1898). An unmapped locality is Averyville (Harper 1929). The last specimen was taken in 1938 (Yeager 1950).

FISHER: Occurred at one time through all but the southwestern part of the state, extending as far west and south as Buffalo (Miller 1899), Munro County (Specimen examined), northern Delaware County (specimen examined), and Rennselaer County (Audubon and Bachman 1851-1854). Grant (1906) reported that they were confined to the Adirondacks by 1842, although Mearns in 1898 wrote that they were still taken occasionally in the Catskills, and Miller's Buffalo specimen was captured in 1899. By 1900 they were restricted to the Adirondacks (Grant 1906), where they still occur. According to Hamilton and Cook (1955) they have in recent years

increased their numbers and extended their range in the Adirondacks, so that they now occur through at least parts of St. Lawrence, Franklin, Clinton, Lewis, Oneida, Herkimer, Hamilton, Essex, Warren and Saratoga counties. These authors present a distribution map of fisher for the state.

NORTH CAROLINA

FISHER: Known only from one specimen reported by Audubon and Bachman (1851-1854) which was taken from Buncombe County in the western part of the state. Kellogg (1937) wrote that they once occurred, without adding detail. Aside from a Pleistocene fisher found in Arkansas, this is the most southerly record known east of the Great Plains.

NORTH DAKOTA

MARTEN: Common in the wooded northeastern part of the state a century ago, but have been long extinct (Bailey 1926a, Allen 1942); known records are from Pembina County (Bailey), Walsh County (Bailey; Swanson, Surber and Roberts 1945) and Grand Forks County (Bailey). Another unmapped record is the Hair Hills (Bailey).

FISHER: Audubon and Bachman (1851-1854) reported having seen many skins from the "upper Missouri" and hence possibly from this state. Bailey (1926a) said that they formerly occurred in the northeastern part, but that they are now extinct. Records are known from eastern Cavalier, Pembina, Walsh and Grand Forks counties and from the Hair Hills. The last of these is unmapped (Bailey 1926a; Swanson, Surber and Roberts 1945; and Over and Churchill 1945).

NORTHWEST TERRITORIES

MARTEN: All of the Territories south of the barrens (Ross 1861a and b and 1862, MacFarlane 1905, Mair and MacFarlane 1908, Preble 1902 and 1908). They have occasionally been taken on the barrens some distance from tree line (Degerbol 1935, Clarke 1944 and Banfield 1951). The greatest numbers of martens were taken during the period 1840-1860, according to Seton (1925-1928), but since then numbers have steadily decreased (many authors). The annual catch in the years 1851-1860 exceeded 30,000 pelts, but by 1930 the average had dropped to about 5,000. The chief collecting places are now Forts Simpson, Good Hope, Norman, Aklavik, Rae. Smith, Resolution and Providence, in that order of importance (Robinson and Robinson 1946). An unmapped record is Fort Anderson (Preble 1908).

FISHER: Known from the Mackenzie District only, not to my knowledge from Keewatin; were originally well known as far north as Resolution on the shore of Great Slave Lake (Richardson 1829, Ross 1861a and b, MacFarlane 1905, Russell 1898, Preble 1908, Seton 1911), although never common at its northern limit (Ross 1862, MacFarlane 1905, Russell 1898). Russell said that they were not found between Great Slave and Athabaska lakes except along the Slave River, which is their eastern limit, although they were common on the numerous deltas of the Slave (Ross 1861a). Russell said that to the west they have been seen just north of Providence, and the Liard River has been considered a more westerly northern limit (Preble 1908, Seton 1911, Mason 1924). Seton (1911) said that the natives considered the point where the north Nahanni enters the Mackenzie the most northerly limit of fisher in the district. Patterson (1954, pp. 76 and 180) saw fisher tracks on the south Nahanni northwest of Caribou Creek and in Deadman's Valley. MacFarlane (1905) reported that specimens had been taken at Whitefish Lake, which I locate about 125 miles east of Resolution, and Clark (1944) said they have been taken at the headwaters of the Anderson River, which I map north of Great Bear Lake. Both are likely incorrectly mapped. The number of fishers taken in the territory has never been great, and are now very low. Clark (1944) wrote that "for a number of years no fisher have been reported from the Mackenzie District except in the Fort Liard area. At this post a very few skins from the Mackenzie District are traded annually."

NOVA SCOTIA

MARTEN: Originally probably all of Nova Scotia (Smith 1940), and according to Coues (1877) and Bailey (1896) once common; now very rare, and found only in restricted areas (Smith 1940). No specimens have been collected legally for some time, but Rand in 1933 had heard of one smuggled out shortly beforehand. They are present on Cape Breton Island (Rowan 1876, Rand 1944b). D. Benson says that two were trapped there in 1954. Seven marten have been brought from Ontario, are now in quarantine, and are to be released on the mainland shortly.

FISHER: Gilpin (1868) listed them as present, but there has been no record of them since (Smith 1940, Allen 1942, Rand 1944b). D. Benson says that several fisher were released in the southwest part of the province six or eight years ago. Very recently a three-year-old female was trapped in the same region. Benson thinks it likely that it represents progeny of the introduced stock.

OHIO

MARTEN: Kirtland (1838) reported that "the pine weasel is admitted to the state's fauna on the authority of Dr. Ward, who informs me that it was taken in the vicinity of Chillecothe." Brayton (1882), quoting a letter of one Emory Potter, listed them as "extinct in Ohio." Bole and Moulthrop (1942) have examined two specimens believed collected in Ashtabula County. They concluded that they have been extinct for about one hundred years. The Chillecothe record, if correct, marks the most southerly record known for the area east of the Great Plains.

FISHER: Kirtland (1838) stated that two specimens had been taken in Ashtabula County in 1837. Brayton (1882) listed fisher as a member of the state's fauna. Bole and Moulthrop (1942) said that a specimen (possibly Kirtland's) taken in the state was held in the Cleveland Museum of Natural History. Leedy (1950) considered fisher rare or absent. No other records of its occurrence are known to me.

ONTARIO

MARTEN: Apparently once common throughout the whole of the province except for the barrens just south of Hudson Bay. They now occur no further south than the southern limits of Algonquin Park (Cross and Dymond 1929, Downing 1948, de Vos 1952), and they are made up of many small disjunct populations, the largest centering around the area fifty to seventy-five miles west of Timmins (de Vos 1952). At one time they apparently occurred all through southern Ontario, at least as far south as Essex County and Rondeau, as the following evidence indicates. Small and Lett (1884, Trans. Ottawa Field Nat. Club 6: 150-151 and 280-283) and Rand (1945a) said that they occurred near Ottawa about 1840, and Seton (1925-1928) said that they were found between Lake Simcoe and Ottawa in the 1870's. They occurred at Whitechurch, ten miles north of Toronto (Seton 1925-1928) and near Toronto in 1830 and "much later" (Faull 1913). They were believed to have once occurred near Hamilton (Warren 1950), and in the upper Thames watershed (Richardson 1952); and Saunders (1932) was told in 1899 that they had been seen at Rondeau. De Vos (1952) wrote that Volume 3 of the Census of Canada, 1870-1871, recorded fur returns of marten from the following ridings: Essex, Kent, Brant, Simcoe, Victoria and Peterborough. Marten skeletons have been found in the late pre-European middens of Prescott, Brantford and London (Wittemberg 1919, 1939 and 1948). F. Merner has told me that a marten was taken near Hespeler about 25 years ago. Marten refuges have recently been formed on the east coast of James Bay and on Akimiski Island (de Vos 1952). I do not know if marten have ever naturally occurred on the island.

FISHER: Formerly present throughout all of the province except the unforested lowlands bordering Hudson Bay. Now their range extends no further south than the French and Mattawa Rivers, and Algonquin Park (Rand 1944a, Downing 1948, de Vos 1952). De Vos's map showed the population to be divided into three major groups, one centering around Central Patricia, one around Timmins and one around Algonquin Park. Originally fisher occurred in the southern part of the province as the following records show. Audubon and Bachman (1851-1854) recorded one shot at Port Hope. Gapper (1830) mentioned one taken between Toronto and Lake Simcoe. Saunders (1932) stated that he had been told that they had occurred at Rondeau and at Burks Falls at the turn of the century. Richardson (1952) believed they had once occurred in the upper Thames watershed. Wittemberg (1939, 1948) recorded them from the late pre-European middens of London and Brantford. Localities not mapped are McClure Township and Quinte Forest District (de Vos 1952).

OREGON

MARTEN: Throughout the Coast Mountains and Cascade Mountains from the northern to the southern boundaries of the state, as far east as western Crook County (Bailey 1936) and Des Chutes River (eastern Wasco County) (specimen examined). Also present in the Blue Mountains in the northeastern part of the state, as far west as Grant County (Bailey 1936, Anon. 1951 and 1952) and as

far south as Prairie City (specimen examined). Marten were being trapped in 1952 (Anon. 1952). An unmapped locality is Olive Lake (Bailey).

FISHER: Through the Coast Mountains and the Klamath and Cascade Ranges of the state, from the northern to the southern boundaries, as far east as eastern Hood River, eastern Douglas and central Jackson Counties (Bailey 1936). Also present in the Blue Mountains of the northeast, at least as far east as central Umatilla County, and as far south as southern Union County (Bailey). According to Bailey, they are united with the western population in the area north of the High Desert and Harney Basin.

PENNSYLVANIA

MARTEN: Once abundant in the northern mountains of the state, but were exterminated by 1900 (Rhoads 1903, Richmond and Roslund 1949). Their southern limits in the state appear to have been Crawford, Forest, Elk, Cameron, Clinton, Tioga, Sullivan, Columbia, Wyoming and Wayne counties (Rhoads, Shoemaker 1919). Rhoads wrote that they also occurred in Lancaster County; if this is so, it is the most southerly record known in the Appalachian Mountains, aside from an old Ohio record.

FISHER: At one time through all of the northeastern half of the state (Rhoads 1903), occurring as far south as Forest, Elk, Clearfield, Centre, Cumberland and Lancaster Counties (Rhoads 1898 and 1903, Shoemaker 1919, Hamilton 1943 and specimens examined). Roslund (1951) believed that fisher had become extinct by 1903, but Poole (1932) reported that one was taken at Holtwood in 1921. Localities not mapped include Second Mountain and Peter Mountain (Shoemaker) and Mountain bog above Strausstown (Poole).

PRINCE EDWARD ISLAND

FISHER: "In Prince Edward Island . . . there are now no fisher" (Rand 1944a). Whether or not Rand meant this to signify that fisher once occurred there I do not know.

QUEBEC (including Labrador)

MARTEN: Common at one time throughout all of Quebec and Labrador north to the tree line (Bell 1884, Low 1895 and 1896, Bangs 1898, Anderson 1931-1932, Strong 1930 and Tanner 1944). Inland they were abundant everywhere (Stearns 1883) but north of Mistassini they occurred chiefly in the forested river valleys (Low 1895 and 1896, Strong 1930). The numbers trapped per year have dropped from 12,000 in 1870 to 1,200 in 1949-50 (Minville 1946, Anon. 1927-1950). They occur as far north as Chimo and Upper Seal Lake and as far west as George and as far east as the barrens edging the Labrador Coast (Doutt 1954, and specimens examined). In spite of the fact that they are known from adjacent New York, New Hampshire, Vermont, Maine and New Brunswick, and though Hall (1861) recorded them from near Montreal, Cameron and Orkin (1950) from Laurentides Park, and though they are known to be present though scarce on the Gaspé Peninsula (Cameron 1953 and specimens examined), there are no records for their occurrence in the Eastern Townships. Verrill (1862) and Rowan (1876) reported that marten occurred on Anticosti Island. Hunter (1907) said he had examined specimens of these, and Newsom (1937) was assured of the former presence of marten on the island. D. H. Pimlott (letter) writes that the last specimen from the island was trapped in 1926, and that tracks have not been seen since 1931.

FISHER: In Quebec known only south of a line connecting the southern end of James Bay, Lake Mistassini, and Mingan (Bell 1884, Low 1895 and 1896, Anderson 1938 and specimens examined). Stearns (1883) wrote that they were occasionally found in the southern portions of Labrador, and Eidmann (1935) said the natives reported them to occur occasionally in the Matamek region. Hunter (1907) wrote that "... prior to about the year 1860 the fisher ... was ... unknown to the trappers on the north shore ... east of the Saguenay and it was only after that year that an odd one was trapped in that lower country" On the south shore of the Saint Lawrence they were reported from Ile Ste. Hélène (Achintre and Crevier 1876) and the Gaspé Peninsula (Goodwin 1924, Cameron 1953). No fisher were known from Anticosti, and while two were released there a number of years ago, they were never seen again (Newsom 1937). Fisher have become very much scarcer in the province than they were originally (Neilson 1948, Cameron 1953, Minville 1946). Localities not mapped: Eureka Lake, Pontiac County (specimen examined).

RHODE ISLAND

FISHER: Included by Mearns (1900) in his list of the state's original fauna, but as far as I know never substantiated.

SASKATCHEWAN

MARTEN: The northern wooded portion of the province, probably as far south as the southern limit of aspen parkland, and at least as far south as the southern limit of the coniferous forest. Records for the province are scarce, the most southerly being Ile a la Crosse in the west and Pas Mountains and Redearth in the east (L. Butler, letter and specimens examined). I have examined a specimen from Duck Mountain in Manitoba, just across the border from Saskatchewan, and about 150 miles south of Pas Mountains and Redearth. Twenty-five hundred skins were taken in 1919-1920, but this was reduced to 375 by 1949-1950 (Anon. 1927-1950). The chief collecting points are Fond du Lac, Ile a la Crosse, and Pelican Narrows (L. Butler, letter).

FISHER: Forested Saskatchewan, at least as far south as Little Red River (L. Butler, letter), and Redearth (specimen examined). Although once present in Prince Albert Park, they were believed to be extinct. Since 1945 however, a few animals have been seen in the area (Soper 1952). They are now collected chiefly near the Saskatchewan and Churchill Rivers, Lac la Roche, Montreal Lake and Cumberland House (L. Butler, letter).

SOUTH CAROLINA

FISHER: Said by Seton (1925-1928) to occur in the mountains as far south as South Carolina. I know of no other record, and Seton's is likely incorrect.

SOUTH DAKOTA

MARTEN: "A specimen... was taken in the Black Hills near Custer in January, 1930, which is the only authentic record for the state. However, there is every reason to assume that before the white trapper entered the region the pine marten roamed in the wooded area up the eastern side of the state and in the Black Hills as a straggler" (Over and Churchill 1945). A record of a marten taken from Pringle in the Black Hills is held in the files of the U.S. Fish and Wildlife Service.

FISHER: "There is no authentic record that it was ever taken in South Dakota territory, but early trappers mention it as frequently seen in the Red River valley of North Dakota, and it is likely that before the advent of white man it inhabited the timbered regions of the eastern side of the state.... No doubt it lived sparingly in the Black Hills in the early days" (Over and Churchill 1945).

TENNESSEE

FISHER: Known only from specimens taken in western Cumberland and Cocke Counties (Audubon and Bachman 1851-1854, Merriam 1886, Rhoads 1896). They have likely been extinct for at least 75 years.

TEXAS

FISHER: Lydekker (1901-1904) and Anthony (1917) both reported that they occurred in the northern part of the state. These may be references to the area once known as Texas Territory; I do not believe that the fisher ever occurred within the limits of present day Texas.

UTAH

MARTEN: Occur through the Wasatch and Uinta Ranges of the Middle Rocky Mountains, as far west as Salt Lake and Utah counties and as far south as Lost Lake, Wasatch County, if not further; present also in the Colorado Plateau region of the southeastern part of the state, in San Juan and Grand Counties (Durrant 1952 and specimens examined). Small numbers of marten were collected in 1949-1950 (Yeager 1950).

FISHER: Durrant (1952) included fisher in the state's fauna on the basis of photographs of fisher tracks taken by William Marshall at Trial Lake in Summit County in 1938. Other tracks were seen in the same place the following year. Durrant considered evidence for its presence in the state to be "unimpeachable."

VERMONT

MARTEN: Originally common throughout the mountainous portions of the state (Kirk 1916, Osgood 1938); reported scarce by 1840 (Seton 1925-1928) and nearly extinct at present (Osgood, Foote 1944). Osgood reported that the last specimen was taken in 1926. Records are known only from Rutland, Bennington, and Windham Counties (Kirk 1916, Osgood 1938).

FISHER: Known originally throughout the Green Mountains from La Moille to Rutland counties (Kirk 1916, Osgood 1938, Foote 1944 and specimens examined). By 1916 had been confined to "the wildest mountain districts"

(Kirk) and by 1938 were very nearly extinct (Osgood). Their present status in the state is uncertain (Foote). Locality not mapped is Meridan (Kirk).

VIRGINIA

MARTEN: Bailey (1946) wrote that the "Account Showing the Quantity of Skins and Furs Exported Annually... from Virginia from... 1698 to ...1715" listed marten, and that Thomas Jefferson in his "Notes on the State of Virginia" (1801) included them. Audubon and Bachman (1851-1854) reported that "we have sought for it in vain on the mountains of Virginia where notwithstanding, we think a straggler will occasionally make its appearance." Anthony (1928), Bailey (1946), Brown (1952) and others all listed them as likely former inhabitants. Handley and Patton (1947) reviewed the situation and reached the following conclusion: "Although its range has been given by dozens of authors, even to the present day as 'extending south in the mountains to Virginia', we have been unable to find record of any specific evidence of its occurrence south of Pennsylvania. It is not inconceivable, however, that it might have occurred in the... spruce forests that formerly covered eastern West Virginia and extended into the Virginia Mountains...."

FISHER: The "Account Showing the Quantity of Skins and Furs Exported Annually..." listed fisher as being taken, according to Bailey (1946). Audubon and Bachman (1851-1854) said that they saw them on the mountains of the state, and Allen (1876b) wrote that they once occurred there. Poland (1892) suggested that their German name "Virginian fitch" implied their presence. Handley and Patton (1947) reported that "we have been told by old residents of the Crabbottom section that 'Black foxes' had been killed in Highland County as late as 1890... and it seems reasonable to believe that these may have been *Martes pennanti*. Before the advance of civilization... fishers were probably common in many parts of western Virginia...." They are now extinct (Handley and Patton, Brown 1952).

WASHINGTON

MARTEN: Occur in the Olympic Peninsula, and south in the Coast Mountains to Chehalis, at least (specimens examined); the Cascade Mountains from the international boundary to the Columbia River, west to Camp Skagit, Mount Vernon, and Hamilton (specimens examined), and east to eastern Chelan County and Chelan (Dalquest 1948 and specimens examined); present in the Columbia, Bitterroot and Selkirk ranges of the northeastern part of the state (Dalquest, Anon. 1931 and specimens examined) and the Blue Mountains of the southeastern part. The last marten were taken in 1946-1947, the season being closed since (Dalquest).

FISHER: Occur in the Olympic and Coast mountains from the northern tip south to Grays Harbor (Dalquest 1948, Elliot 1899 and 1907 and specimens examined); apparently absent from the Puget Lowland except at low altitudes in Mason and Pierce Counties (Scheffer 1938 and specimens examined); present in the Cascade Mountains from the international boundary south to the Columbia River, as far west as eastern Whatcom, Snonomish and central King counties, and as far east as central Okanagan, Chelan and Yakima counties (Dalquest, Scheffer, Taylor and Shaw 1929, Rhoads 1898, Potts and Grater 1949, Baird 1857 and 1859). Dalquest believed that it was possible that a few exist or existed in the Columbia, Selkirk and Bitterroot ranges of the northeastern part, and in the Blue Mountains of the southeastern part of the state. Localities not mapped are: Iron Creek (specimen examined), Billy Goat Mountain, Head of Cascade River, Granville and Suez (Scheffer).

WEST VIRGINIA

FISHER: Occurred originally through most of the mountainous parts, and apparently still present in very small numbers. Surber (1912) reported them quite common formerly, but rare at time of writing. Kellogg (1937) said they were once present, and Brooks (1924) recorded one taken in Upshur County. McKeever, Frum and Berard (1951) reviewed the above records and added to them as follows. Fred Brooks reported in 1911 that they had been common fifty years earlier, but that they were rare or extinct at the time of relating. He said that three were caught in the early seventy's in northern Boone County. A fisher was trapped in Gilner County in 1949, according to these authors and there appears to be no doubt as to its correct identity. A record not mapped is from Clear Fork, Big Coal River (Kellogg 1937).

WISCONSIN

MARTEN: Formerly in the wooded portions of the northern part of the state, at least as far south as St. Croix, La Cross, Jackson, Juneau and Brown Counties (Shorger 1942);

nearly extinct by 1900 (Jackson 1908, Cory 1912 and Barger 1951). Shorger wrote that the last specimen was taken in 1925; according to de Vos (1951) they still occur in very small numbers. Shorger reported them from Outer Island of the Apostle Island group in Lake Superior in 1934.

FISHER: Said by Jackson (1908), Hollister (1910), Cory (1912) and Barger (1951) to have occurred through almost all of the state at one time, but to be lacking in any specific records. Cory believed that they still existed, and Shorger (1942) was positive of their presence at time of writing; Barger believed however that they had become extinct by 1900. The only records are those given by Shorger for La Cross, Sauk, Jefferson and Milwaukee Counties.

WYOMING

MARTEN: Reasonably common in the forested areas of the Wasatch and Yellowstone sections of the Middle Rocky Mountains of the western part of the state (Cary 1917, Seton 1925-1928, Bailey 1930, Cahalane 1943, Anon. 1950 and Thomas 1952b). Occur from Yellowstone Park south to La Barge Creek, Lincoln County (specimen examined) and as far east as western Park County (U.S. Fish and Wildlife Service file), and Dinwoody Canyon, western Fremont County (specimen examined). No specimens were trapped in the year 1948-1949 (Yeager 1950).

FISHER: Known only from Yellowstone and Shoshone counties in the northwest corner of the state (Skinner 1927, Cahalane 1947, Thomas 1952a and Anon. 1950). This is considered their southern limit in the Rocky Mountains (Seton 1925-1928, Allen 1942, Handley and Patton 1947, Summer and Dixon 1953) although they are known from northern Utah. Are now extinct or nearly so (Skinner, Anon. 1950, T. J. Grasse, letter). According to Thomas the first specimen taken in the state was captured early in the 1920's, although tracks had been observed previous to this. None have been taken since about 1940 (Anon. 1950). Reports indicate that they exist now only in the Absaroka Range of northern Park County (Thomas).

YUKON TERRITORY

MARTEN: Present through all of the forested part of the Territory, at least as far north as Macmillan River (Mason 1924, Rand 1945c). Their present status is good and promises to remain so (Rand 1944c) although the present total take is not equal to that of the catches of some single trappers thirty-five to forty years ago (Rand 1945b). A locality not mapped is the lower Yukon region (Twitchell 1921).

FISHER: Rand (1944a) wrote that they barely enter the southern Yukon. The same author (1945b) reported that "Mr. Drury of Whitehorse... trades a few fisher, but they do not average one a year, and he did not know of a single pelt that had undoubtedly been taken in Yukon.... That fisher do occur in southeast Yukon, as usually assumed, is supported by trappers Leitman and Carmen of Tobally Lakes, and Larsen of Beaver River. The former have taken three in several years' trapping; the latter one fisher in several years' trapping...." Rand (1945c) sai dtwo to thirty-eight skins have been traded in Yukon from 1920 to 1942, but gave no assurance that any were taken within the Territory. Turner (1886) reported that they occurred in the upper Yukon valley, but I do not know if he meant that portion in the Territory or not.

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Ralph R. DeLong.

RALPH EMERSON DeLURY

1881-1956

More than fifty years ago when I first made the acquaintance of a chemical laboratory at the University of Toronto one of the instructors was Ralph DeLury. His guidance and his cryptic red-ink remarks on my laboratory notebooks are vividly remembered yet. For a time our paths separated only to meet again at Ottawa where he was an astronomer at the Dominion Observatory and I had been appointed to administer Dominion wildlife protection.

Ralph DeLury joined the Ottawa Field Naturalists' Club in 1916, and later became a Sustaining Life Member. He served on Council from 1920 to 1947, and as Second Vice-President in 1936 and 1937. He did not wish to accept higher office.

For the period 1920 to 1940 spring excursions were held in May at Fairy Lake, near Hull, Quebec, and it became customary for DeLury, one of the leaders, to furnish, for comparative purposes, multigraphed lists of birds found in previous years. He was especially interested in comparing dates of arrival from year to year.

Ralph DeLury was active, with others at Ottawa, in taking the Christmas Bird Census and sometimes served as Chairman of our Bird Census Committee. His party had an excellent regular route — Experimental Farm and along Rideau Canal and River to Black Rapids — and had great success in finding many birds of interest. The last census he took here was in 1945.

Another Club activity of his was to serve as a member of the important Publications Committee.

In the early 1920's, when radio was new in Ottawa, the Club furnished a program of lectures and Ralph DeLury was one of our speakers. He proceeded to chat into a microphone as readily as though this had always been his practice.

At the Club evening lectures he spoke infrequently on such topics as "Photographing the Birds" (March 24, 1938), and "Some Aspects of Bird Banding" (March 16, 1939). His bird banding experiences are described in the Canadian Field-Naturalist (volume 38, pages 21-24, 1924). He was an excellent photographer and his presentations, whether spoken or written, were illustrated by his own wildlife pictures.

His article "The Experimental Farm as a Bird Sanctuary" (Can. Field Nat. 39: 1-4, 1925) is unique in many ways. The photographs and areas discussed, as well as birds mentioned as nesting, are located on an aerial map marked off in 1000-foot lines from the Dominion Observatory which is the geodetic zero point for Canada. Both the observatory and Dr. DeLury's home, as well as nearby Clark's Woods, the waterfowl enclosure, Dow's Swamp, Dow's Lake, and the Rideau Canal are shown. Ninety-three species of birds had been identified at his residence, and if those seen at the Farm or near it are included, the list numbered 136 species in the previous 14 years. The list is given.

R. E. DeLury and his brother, Justin S. DeLury, published one of the first breeding records for the Evening Grosbeak in Ontario (Can. Field Nat. 36: 137, 1922).

DeLury served on our Committee to arrange for the first Canadian meeting of the American Ornithologists' Union, 1926, and took an active part in the proceedings and in the Union's first camp-out at Blue Sea Lake, Quebec.

Birdbanding activities were a regular undertaking at the DeLury residence and in 1926 he banded and measured more than 700 Redpolls there.

As an astronomer his chief study was the sun. From long study of his chosen subject he evolved a mathematical law for the rate of rotation of the sun, which varies with solar latitude. He was keenly interested in fluctuations of plant growth and of animal life and considered that these and many other terrestrial phenomena reflected the sunspot cycle, whatever the mechanism connecting the terrestrial events with the suncycle or cycles might be. His thoughts on the effects of sunspots and life are concisely expressed in the article "Sunspots and Living Things" which appears in the Transactions of the Seventeenth American Game Conference, New York, 1930. His article entitled "Arrival of Birds in Relation to sunspots" (The Auk 50: 414-419, 1923) shows the connection between the date of arrival of several species at Montdidier, France, according to records of the Chandon family, and the sunspot numbers.

Ralph DeLury was short in stature, though of sturdy build; he was quick in action and keen-witted. Perhaps early athletics had a

bearing here, for he had played association football, baseball, and hockey. Probably baseball was his favorite game as he had pitched for Princeton and was star pitcher for Ottawa Y.M.C.A. in the City League. In fact he never lost interest in the game, and followed the local teams and the fate of the big leagues, keeping score meticulously.

DeLury's nature was kindly, equable, humane. He was an enthusiast in his regular scientific work and in nature study which he considered so closely allied to it. His helpfulness to others is indicated by a single incident. Astronomers and a few assistants had spent two hectic weeks in setting up camp and instruments in the Laurentians of Quebec to observe the 1932 total eclipse of the sun. On the night before the eclipse I met him driving away from camp over an execrable trail — his mission: to get a doctor to officiate at the birth of a new Quebecois, Joseph Eclipse Morin. We did not see the total eclipse, except through rain clouds, but we did have a christening party.

Upon his retirement in 1946 Ralph seemed to terminate all Ottawa interests and devote his entire energy to the development of his waterfowl and beaver sanctuary ponds at the old home, Manilla, Ontario. It seems possible that he entered too strenuously into active pursuits at Manilla after sedentary ones at Ottawa.

DeLury's official connection with the Dominion Observatory began in 1907 when he was appointed Observer. From 1913 to 1946 when he retired with the rank of Acting Director he was in charge of the division of solar physics. In addition to his long interest in variations in solar radiation and related phenomena of the earth and the solar system, he has specified the following specialties as his concern: kinetics, amalgam potential, spectroscopy, solar rotation, wavelengths, and arc spectra.

He belonged to many scientific societies as follows: American Astronomical Society, Optical Society of America, Royal Astronomical Society of Canada (President 1936-38), Fellow of the Royal Society of Canada, Fellow of the Royal Astronomical Society, Fellow of the London Chemical Society, Deutsche Astronomische Gesellschaft, Société Astronomique de France, American Society of Mammalogists, American Ornithologists' Union, and Cooper Ornithological Club.

Ralph DeLury, one of a family of nine, was born at Manilla, Ontario, on November 23, 1881, the eighth child and fifth son of Daniel DeLury and his wife, Catherine Weir. He attended Port Perry High School and graduated from the University of Toronto attaining his B.A. in 1903, his M.A. in 1904, and his Ph.D. in 1907. While at Toronto both Ralph and his youngest brother Justin lived with the oldest of the family, Professor Alfred T. DeLury. Ralph also studied at Chicago University and was an assistant in Physical Chemistry at Princeton in 1906 and 1907. Both his parents were from Ireland and Alfred T. DeLury's very great interest in Irish history and literature was shared by Ralph throughout the years.

He died in hospital at Port Perry on September 20, 1956, and was buried near there in the family plot at Prince Albert. A sister, Abigail, of Manilla, who was formerly with the University of Saskatchewan, and two brothers, Daniel of Walker, Minnesota, and Justin S., formerly of the University of Manitoba, now of Uxbridge, Ontario, survive. His wife, Isobel MacBrien, died many years ago.

HOYES LLOYD

A PLANT COLLECTION FROM NORTHWESTERN MANITOBA

J. C. RITCHIE
Department of Botany, University of Manitoba, Winnipeg, Manitoba

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INTRODUCTION

Only two major collections of vascular plants have been reported from the entire area of northwestern Manitoba, one by Baldwin (1953) from Reindeer and Nueltin lakes and one by Scoggan (1952) from Baralzon Lake area (Fig. 1). There is no information available about either bryophytes or lichens for this region; Thomson (1950) has provided an account of the lichens of the vicinity of The Pas, about 350 km. (220 miles) south of the area of the present study. The following account presents the floristic data, including Vasculares, Bryophyta and Lichenes, of a botanical survey which was made during the summer of 1955 in the MacBride and Tod lake regions, at 56°50'N., 99°53'W., and 56°35'N., 101°47'W. respectively (Fig. 1). The primary object of the investigation was to describe the vegetation of small areas in detail; thus, at both localities, areas no greater than 500 sq. km. (192 sq. miles) were examined.

This work was made possible by an opportunity to accompany two field parties of the Manitoba Geological Survey, and for this the writer wishes to thank the Mines Branch of the Department of Mines and Natural Resources, Manitoba, and the geologists in charge of the parties, Messrs. L. C. Kilburn and G. C. Milligan who provided hospitality and invaluable assistance in the field. Thanks are due to Dr. H. A. Senn, Head of the Botany Unit, Division of Botany, Department of Agriculture, Ottawa, who arranged for the revision of certain vascular plants in his department; also to Drs. C. R. Ball, H. A. Crum and J. W. Thomson who named the willows, mosses and lichens respectively. The field work and subsequent laboratory work were sponsored in entirety by a grant and postdoctorate fellowship which were awarded by the National Research Council of Canada.

GEOLOGY AND VEGETATION

The area which includes MacBride and Tod lakes is part of the Canadian Shield region of Manitoba. With few exceptions relief is low, the ridges seldom exceeding 150 m. above the level of the lakes. The low undulating terrain consists of glacial clay till, with occasional eskers and sand plains. Neither region falls within the area of Glacial Lake Agassiz, and accordingly lacustrine deposits are absent from the areas. Rock outcrops are frequent and they are all of pre-Cambrian age. Accounts of the geology of the particular areas with which this paper is concerned are available by Milligan (1952) and Kilburn (1956).

In a detailed account of the vegetation of the region (Ritchie, 1956) it is shown that both areas belong to that forest zone which is characterized on mesic sites by a closed forest of *Picea mariana* with a single subsidiary stratum of ground mosses, chiefly *Pleurozium schreberi, Hylocomium splendens* and *Ptilium crista-castrensis;* that is, they lie within the B 22 or northern coniferous section of the boreal forest (Halliday, 1937) which might be referred to as the Southern Spruce Forest Zone (after Hustich, 1949). Stands of *Picea glauca* are rare in the region, being confined to areas of particularly favorable climate and soil drainage. *Pinus banksiana* forms stable forests on extensive outcrop ridges, sand plains and eskers, and also assumes dominance in certain subseral communities which develop after fires. Hollows and depressions between till ridges contain shallow lakes and ponds, peat bog and muskeg.

The preponderance of base-deficient, poorly drained soils provides little diversity of habitat and bears a relatively poor flora. The only area which was comparatively rich in species was found on the northwest shore of Tod Lake where rather exceptional faulting of two series of sedimentary rocks has produced a range of varied, local habitats.

AN ANNOTATED LIST OF PLANTS

The following list of plants amounts to 264 entities, of which 197 are Vasculares, 44 Bryophyta and 23 Lichenes. A comparison of the list of vascular plants with that of Baldwin (1953) is of some interest since the present collection was from localities within the Southern Spruce Forest Zone, Baldwin's Reindeer Lake material is from

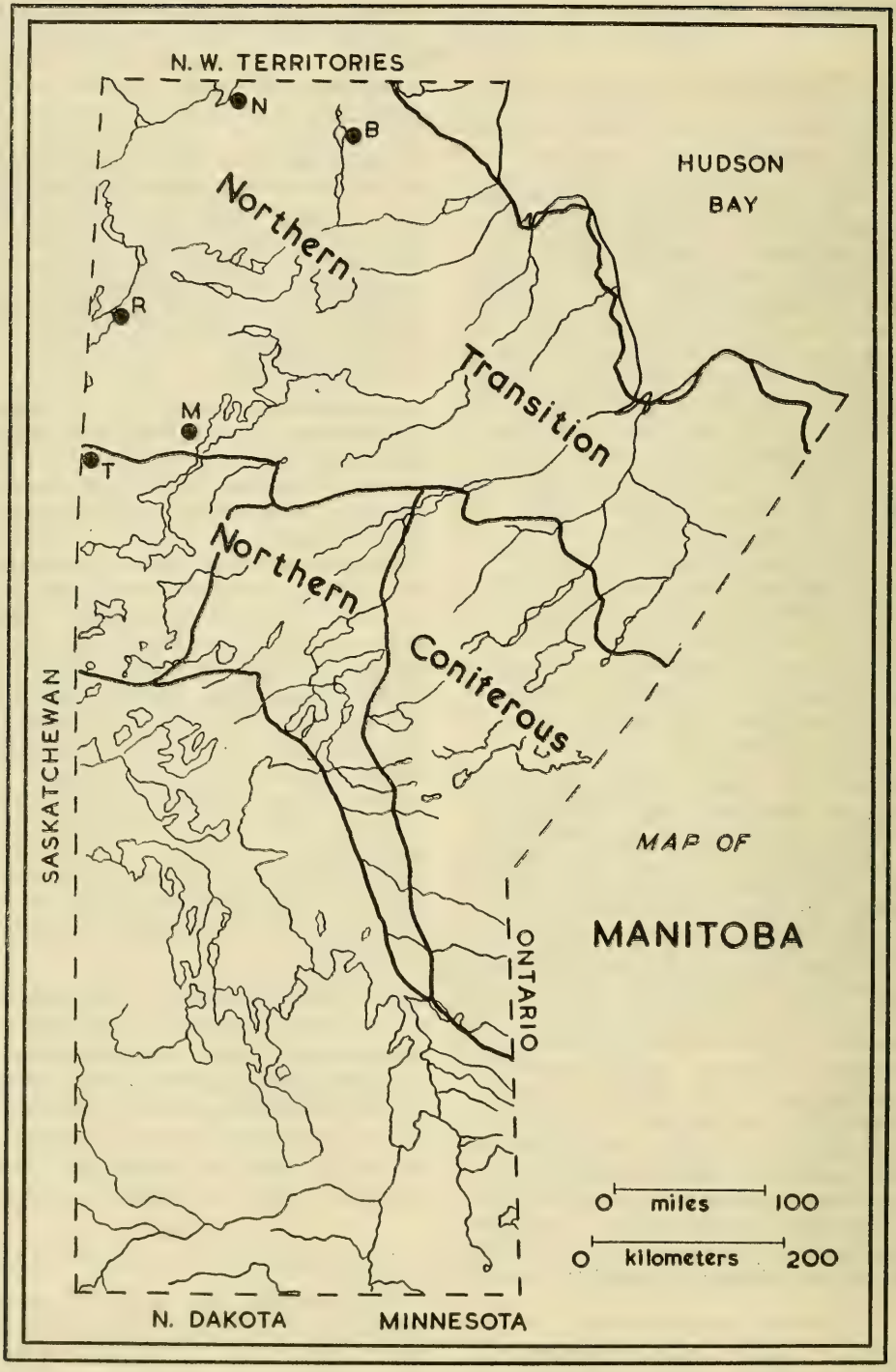


FIG. 1. Map of Manitoba showing the localities from which the present collections were made (M = MacBride Lake, T = Tod Lake), and those of other workers, referred to in the text (R = Reindeer Lake, N = Nueltin Lake, B = Baralzon Lake). The position of the boundaries of the northern sections of the Boreal Forest Region are shown by heavy lines. (After Halliday, 1937.)

a taiga region and his Nueltin Lake plants are from near the southern limit of the forest-tundra zone. In the present list are 64 entities which are not found in Baldwin's list, and of these 50 are strictly boreal plants which probably do not extend beyond the limit of continuous, closed forest. Of the native plants mentioned by Baldwin (loc. cit.) 75 are absent from the present list and of these about 45 are arctic-subarctic species whose southern limit does not extend for any great distance into the forested regions. If this comparison is extended to include the list of Porsild (1950) from that part of Nueltin Lake which extends into Keewatin, it becomes clear that across the three vegetation zones — the Southern Spruce Forest, Taiga and Forest-Tundra Zones — there is a related change of floristic affinity from boreal through subarctic to arctic.

Additions and notable extensions to the flora of Manitoba are marked * and § respectively in the list; they have been treated at greater length elsewhere (Ritchie, 1956a). The nomenclature of the vascular plants includes certain modern treatments but the more common synonyms are appended. The nomenclature of the Musci follows Richards and Wallace (1950). After the name of each entity the locality abbreviations (T = Tod Lake, M = MacBride Lake) and collection number are given, followed by brief ecological notes. A complete set of the plants is in the Herbarium of the University of Manitoba; a duplicate set of the mosses has been deposited in the Herbarium of the National Museum of Canada, Ottawa, and of the lichens in the Herbarium of the University of Wisconsin, Madison.

PTERIDOPHYTA

Equisetum sylvaticum L. var *pauciramosum* Milde. M 936. In damp, shaded parts of spruce forest and muskeg.

Equisetum fluviatile L. M 1036. Common, forming extensive pure stands along lake shorelines and river margins, in 15 - 50 cm. water.

Equisetum scirpoides Michx. M 953. Local, in damp, shaded parts of black spruce forest and related seral types.

Lycopodium annotinum L. T 1274. Locally common on humous soil of open (seral) pinewood.

Lycopodium annotinum L. var. *pungens* (LaPylaie) Desv. M 944, 1042. In shaded, damp hollows on granite outcrops and in shaded parts of the spruce forest.

Lycopodium clavatum L. T 1303. Local, found in a damp, shaded carpet of *Pleurozium* in a closed black-spruce forest on Tod Lake.

Lycopodium obscurum L. T 1276. Local, found in an open seral pinewood over a well drained clay loam soil.

Lycopodium complanatum L. M 937, 1043. T 1275. Local but widespread in shaded, mossy sites in spruce and pine forest types.

§ *Botrychium lunaria* (L.) Sw. M 1124. Recorded from only two localities, both habitats having well-drained substrata and high insolation.

Woodsia ilvensis (L.) R.Br. M 1178, 1209. T 1236. Local but common, confined to shaded outcrop crevices and ledges.

* *Woodsia alpina* (Bolton) S. F. Gray. T 1264. In a deeply shaded locality, growing in a narrow ledge of a granite outcrop; the only record.

Cystopteris fragilis (L.) Bernh. T 1233. Local, found in shaded but dry outcrop and ridge crevices.

§ *Cystopteris dickieana* Sims. T 1263. The only locality, growing with *Woodsia alpina* on a damp, shaded outcrop ledge.

Dryopteris robertiana (Hoff.) Christens. T 1261. Local, found in a crevice of a N.-facing, shaded outcrop ridge.

Dryopteris fragrans (L.) Schott. T 1234, 1235. Locally common on exposed and partly shaded outcrop rock surfaces.

* *Thelypteris phegopteris* (L.) Slosson T 1257. The only locality, growing under black-spruce and balsam poplar in wet, silty soil near a small beaver dam.

Cryptogramma acrostichoides R. Br. T 1298. The only record from the area, growing on the exposed surface of a granite outcrop under open jackpine.

Polypodium virginianum L. M 1079, T 1260. Locally common, under spruce on a N.-facing granite outcrop.

SPERMATOPHYTA

Picea glauca (Moench) Voss M 1226. Of local occurrence, it appears to be confined to sites with southern aspects and particularly well-drained, mineral soil and to local alluvial soils.

Picea mariana (Mill.) BSP M 935. Dominating forests on moderately well-drained soils and muskegs.

Larix laricina (DuRoi) K. Koch M 1014. Most common in wet parts of peat bogs, it

was also recorded in seral sprucewoods on drier soils.

Pinus banksiana Lamb. M 1060. The dominant of forests on outcrop ridges and sand plains, it also occurs as dominant of seral forests on clay loam soils.

Juniperus communis L. var. *depressa* Pursh M 1068. Locally common, particularly on exposed, sunny shoreline outcrops and slopes.

Sparganium minimum (Hartm.) Fries M 1092. The only record, growing at the margin of a shallow peaty pool.

Sparganium angustifolium Michx. M 1075. Common in the marginal community of shallow lakes and slow rivers, in ½ — 1 m. water.

§ *Potamogeton robbinsii* Oakes M 1214. The only locality, forming a dominant submerged zone at 60 cm. in a shallow arm of MacBride Lake.

Potamogeton alpinus Balbis var. *tenuifolius* (Raf.) Ogden M 1215, 1219. Locally common in shallow, marginal zones of lakes and river extensions.

Potamogeton gramineus L. M 1136. Locally common in shallow, peaty lakes with *Nuphar variegatum*.

Potamogeton richardsonii (Ar. Benn.) Rydb. M 1031, 1076. Common in rivers and lakes, growing in ½ — 1 m. water on silted bottoms.

Triglochin maritima L. M 1010. Local, confined to the wetter areas of peat bogs.

Scheuchzeria palustris L. var. *americana* Fern. M 1007. Local, recorded in the wetter parts of a few peat bogs.

Sagittaria cuneata Sheldon M 1132, 1181, 1227. Common in marginal aquatic communities of shallow lakes and river extensions, growing in ½ — 1 m. water.

§ *Schizachne purpurascens* (Torr.) Swallen T 1247. Only one record, from the S.-facing slope of a high outcrop ridge.

Glyceria straita (Lam.) Hitchc. var. *stricta* Fern. T 1258. Local, recorded in the wet silty soil round a small beaver dam.

Poa palustris L. M 1072. Local, recorded in damp clay over a shoreline outcrop.

Poa glauca Vahl M 1089, 1238, 1243, 1292, 1294. Common in many unshaded sites with well-drained soils.

Poa ?interior Rydb. M 1224. In well-drained soil with juniper and *Rhytidium rugosum* under white-spruce.

Roegneria violacea (Hornem.) Meld. (*Agropyron violaceum* (Hornem.) Lange) T 1249. Recorded from the well-drained mineral soil on the upper, S.-facing flank of a high outcrop ridge.

Trisetum spicatum (L.) Richter M 1070. Of local occurrence, it was recorded only from certain exposed, sunny shoreline outcrops.

Calamagrostis canadensis (Michx.) Nutt. M 1105, 1189, 1289. Locally dominant on dry, organic substrata.

Calamagrostis inexpansa Gray M 1041. Frequent but local, growing in areas of impeded drainage under spruce and pine canopies.

Calamagrostis lapponica (Wahl.) Hartm. var. *nearctica* Porsild T 1272. Local on clay-loam soil of an open, seral pinewood.

Agrostis scabra Willd. M 1102, 1175, 1287. Local, confined to habitats with well-drained soils; in outcrop crevices and open areas on clay soil under seral pinewood.

Oryzopsis pungens (Torr.) Hitchc. M 1126. Locally common on open clay soil under subseral pine forest.

Eleocharis acicularis (L.) R. & S. M 1037, 1210. Local, growing in mineral, or partly peaty substrata, at lake margins and the edges of lake bogs.

Scirpus atrocinctus Fern. T 1299. Recorded from one locality, growing in the wet, silty soil of a small stream.

Eriophorum medium Anders. M 1009, 1187, 1267. Occasional in the wetter parts of peat bogs.

Eriophorum brachyantherum Trautv. (*Eriophorum opacum* (Björnstr.) Fern.) M 958. Local, occurring in open patches of spruce muskeg communities.

Eriophorum spissum Fern. M 1038, T 1266. Infrequent, recorded in a peaty depression on a high outcrop ridge, and in a peat bog.

Eriophorum gracile W. D. J. Koch M 1011. In the outer, wet zones of peat bogs.

Eriophorum angustifolium Honck. M 1187a. Occasional in the outer zones of a few peat bogs.

Carex gynocrates Wormsk. M 956, 1005. Infrequent, found in drier parts of spruce muskeg vegetation.

Carex chordorrhiza L. M 1148. Locally abundant but not widespread, confined to wet *Sphagnum* mats in peat bogs.

Carex diandra Schrank M 963. Local, recorded in the wetter areas of peat bogs, associated with *Menyanthes trifoliata*.

§ *Carex heleonastes* Ehrh. M 968, 1024, 1147, 1185. Occasional, in hummocks of *Sphagnum warnstorfianum* and *Camptothecium nitens* in peat bogs.

Carex disperma Dew. M 976, T 1296. Occasional in spruce muskeg.

Carex trisperma Dew. T 1268. Local, recorded at the edge of a muskeg lake with *Myrica gale* and *Ledum groenlandicum.*

Carex tenuiiflora Wahlenb. M 975. Locally abundant in spruce muskeg and peat bogs.

Carex canescens L. M 1040, 1100, T 1285. Common on wet organic soil at pond margins and in peat bogs.

Carex brunnescens (Pers.) Poir. M 1039, 1056, 1061, T 1296a. Common in dry humus of outcrop crevices and depressions.

Carex bebbii Olney M 1101. Local, forming tussocks at the margin of a small pond; growing in wet peat.

§ *Carex leptalea* Wahlenb. M 1143. The only record, growing in a wet peaty stream in muskeg with *Carex paupercula* and *Caltha palustris.*

Carex deflexa Hornem. M 1045. Local, found in damp humus of outcrop crevices with *Corydalis sempervirens* and *Cladonia* spp.

* *Carex abdita* Bickn. T 1242. The only record, growing in dry mineral soil on the southern aspect of a high outcrop ridge.

Carex concinna R. Br. M 1115. Very local, growing with *Aulacomnium palustre* in a damp hollow on clay under an open, seral pinewood.

Carex aquatilis Wahlenb. M 979, 1016, 1099. Common, forming local pure stands in wet peaty habitats at pond and bog margins.

Carex media R. Br. M 1069, 1103. Occasional, occurring in damp humus at pond margins, shoreline outcrops and muskegs.

Carex limosa L. M 965. Common in the wetter parts of peat bogs.

Carex paupercula Michx. M 1142. The only record, forming local tussocks in a small muskeg stream.

§ *Carex lasiocarpa* Ehrh. var. *americana* Fern. M 1219, 1221. Local, forming a narrow zone of dominance at the margin of a lake bog.

Carex vaginata Tausch. M 955, 1093. Occasional, found in damp peat of spruce muskeg vegetation.

§ *Carex oligosperma* Michx. T 1270. The only locality, forming a closed sward in a small damp swampy area over clay.

Carex rostrata Stokes M 1012, 1034, 1098, 1135. Common, in shoreline communities and at pond margins.

Carex vesicaria L. M 1218. Forming a zone of dominance at the outer margin of lake bog vegetation.

Calla palustris L. M 1204. Locally common, in shallow lakes where it forms the outer marginal zone in wet, silty peat.

§ *Acorus calamus* L. M 1228. The only record, forming a small stand at the shoreline of MacBride Lake in shallow water.

Juncus brevicaudatus (Engelm.) Fern. T 1308. The only record, growing in wet sand at the margin of a small depression in a sand plain pineforest.

Juncus filiformis L. T 1269. Local, recorded with *Carex oligosperma* in an open swampy area over clay.

Smilacina trifolia (L.) Desv. M 974. Widespread, confined to areas of wet, peaty substrata; in muskeg and bog.

Maianthemum canadense Desf. T 1282. Local, occurring in the ground vegetation of a closed pine forest on a sand plain.

Platanthera hyperborea (L.) Lindl. (*Habenaria hyperborea* (L.) R. Br.) M 1008, 1094. Very local, confined to the wetter parts of apparently eutrophic bogs.

Corallorhiza trifida Chatelain M 1134. The only record, growing in deep shade under a mixed stand of black-spruce, alder and poplar.

Salix pyrifolia Anderss. M 988, 1058. T 1290, 1307. Common, most frequently recorded in spruce muskeg communities.

Salix mackenzieana (Hook.) Barr. M 1117. The only record, growing in an open pine forest over clay (a seral forest type).

* *Salix pseudocordata* (Anderss.) Rydb. M 1113. The only record, found in spruce muskeg beside a small peaty pool.

Salix myrtillifolia Anderss. M 1001. Locally abundant in spruce muskeg, growing with *Ledum groenlandicum* and *Sphagnum fuscum.*

Salix bebbiana Sarg. M 1083, 1116. Common in the region, in several communities; most commonly the chief tree of the woodland fringe of lakes and rivers.

Salix bebbiana Sarg. var. *perrostrata* (Rydb.) Schneider M 934, 1122. Common, the chief tall shrub in stratified, mixed woods (seral).

Salix pedicellaris Pursh var. *hypoglauca* Fern. M 964, 1025. Common, confined to the *Sphagnum*-mat zone of open bogs.

§ *Salix hebecarpa* Fern. (? *S. athabascensis* Raup) M 990, 1029. The only records, both found in spruce muskeg.

§ *Salix petiolaris* Smith M 1205. Forming a discontinuous tall shrub stratum in a stand of white-birch on a dry peat ridge.

Salix discolor Muehl. M 1109, 1230. Not

uncommon, occurring on both organic (muskegs) and mineral (eskers) substrata.

Salix discolor Muehl. var. *latifolia* Anderss. M 978, T 1254, 1255. Common, occurring in depressions on outcrop summits under pine and in muskeg communities with black-spruce.

Salix pellita Anderss. T 1273. Local, recorded in damp clay soil in an open seral pinewood community.

§ *Salix arbusculoides* Anderss. M 985, 989. Of local occurrence in spruce muskeg and peat bog, growing with *Larix laricina*.

Populus tremuloides Michx. M 1188. Occasional, forming local stands after burning on certain ridges and occurring in a few mature mixed stands on low, alluvial substrata.

Populus balsamifera L. M 1130. Local, occurring sporadically in open seral pine forest over clay and on dry, exposed slopes with white-spruce; also locally common along river banks and low lake shores.

Myrica gale L. M 1180. Common, forming a peripheral shrub zone of several shallow peaty lakes and ponds.

Betula papyrifera Marsh. var. *neoalaskana* (Sarg.) Raup M 1059, T 1252, 1265. Widespread, it occurs on mineral and organic substrata forming pure stands on certain very local ridges of the latter.

Betula glandulifera (Regel) Butler M 983, T 1291. Common, occurring in peat bog, muskeg and shoreline vegetation.

Alnus crispa (Ait.) Pursh M 933. Common, forming the shrub stratum of several seral mixed forests on mineral soil, extending into muskegs.

Alnus rugosa (DuRoi) Spreng. var. *americana* (Regel) Fern. T 1300. Infrequent, recorded in the rich peaty silt of a local stream community.

Urtica gracilis Ait. M 1190. Locally frequent, recorded only from rare birchwoods on dry organic substrata.

Geocaulon lividum (Richards.) Fern. M 1067. Locally frequent in the shaded parts of black spruce stands and closed mixed forest types.

Rumex ?fenestratus Greene M 1211. In the outer *Carex-Comarum* zone of a lake-bog.

Moehringia lateriflora (L.) Fenzl (*Arenaria lateriflora* L.) Infrequent, recorded in open tracts between stands of pine on clay soil.

Stellaria longipes Goldie M 1139, 1186. Locally frequent, confined to marginal bog communities.

Stellaria calycantha (Ledeb.) Bong. var. *floribunda* Fern. M 1107. In damp, peaty habitats, at pond margins and in bogs.

Stellaria longifolia Muehl. M 982, 1183. Local, found in wet, eutrophic peat of bogs and muskeg.

Nuphar variegatum Englem. M 1132a. Common, locally abundant along shallow lake and river shorelines in ½ - 1 m. water.

Batrachium subrigidum (W. B. Drew) Ritchie (*Ranunculus subrigidus* W. B. Drew) M 1096, 1216. Found in shallow marginal zones of peaty ponds and lakes.

Coptidium lapponicum (L.) Beurl. (*Ranunculus lapponicus* L.) M 972. Local, in wet, eutrophic peat at the margin of a spruce muskeg.

Ranunculus purshii Richards. (*R. gmelini* DC.) M 971. Local, in small peaty pools of the muskeg-spruce forest ecotone.

Ranunculus reptans L. M 1033. The only record from the area, growing between shoreline boulders in wet mud; it forms a closed sward.

Ranunculus abortivus L. var. *acrolasius* Fern. M 970. Very local, recorded in wet, eutrophic peat at the transition between a muskeg and a spruce forest on a clay ridge.

Ranunculus pensylvanicus L. f. M 1108. Local, noted on a *Calamagrostis*-dominated raised peat ridge flanking a small pond.

Caltha palustris L. M 1137. Locally abundant, found in lake bogs and along the banks of muskeg streams.

Aquilegia brevistyla Hook. M 1086, 1131. Local, confined to open, unshaded habitats of mineral substrata.

Actaea rubra (Ait.) Willd. M 1133. The only record, occurring sparsely in the shaded, damp habitat of a shoreline willow-alder fringe.

Corydalis sempervirens (L.) Pers. M 1057. Confined to the dry humous soil which fills crevices in outcrop ridges; common.

Rorippa islandica Scop. var. *fernaldiana* Butt. & Abbe M 1089. The only record, occurring in damp, apparently eutrophic peat at a pond margin.

Arabis holboellii Hornem. var. *collinsii* (Fern) Rollins T 1253. The only record, found in dry, mineral soil on the southern aspect of a high greenstone ridge.

Drosera rotundifolia L. T 1262. Very local, but abundant where found, it grows in muskegs associated with *Sphagnum* and *Rubus chamaemorus*.

Saxifraga tricuspidata Rottb. M 1073. Local, found on a few shoreline outcrops in humus over rock.

Mitella nuda L. M 949. Locally common, it occurs in damp, shaded parts of closed spruce and mixed forest types.

Parnassia multiseta (Ledeb.) Fern. (*P. palustria* L. var. *neogaea* Fern.) M 1088. Common along shorelines, growing in the damp humous soil of shaded banks.

Ribes oxyacanthoides L. T 1250. Occasional in dry mineral soil of open, S.-facing ridge slopes and shoreline outcrops.

§ *Ribes lacustre* (Pers.) Poir. M 1066. Local, occurring in shaded humus of steep, spruce-clad slopes, growing with *Pyrola asarifolia* and *Linnaea*.

Ribes glandulosum Grauer M 1191. Occasional, growing in dry humus of a white-birch dominated peat ridge.

Ribes triste Pall. M 961. Occasional in damp, low areas of the closed black-spruce forest.

Ribes hudsonianum Richards. M 938, 948. Common in various seral forest types of the black-spruce forest association.

Amelanchier alnifolia Nutt. T 1244. The only record, occurring on the southern aspect of a high outcrop ridge; growing in an unshaded habitat in local abundance.

Fragaria vesca L. s. lat. M 977, 1128. Common, occurring in mineral soils in various communities — in open pinewoods, mixed spruce-birch-pine forest types, and locally, in muskegs.

Sibbaldiopsis tridentata (Ait.) Rydb. (*Potentilla tridentata* Ait.) T 1295. Very local, confined to dry crevice sites on high outcrop ridges under open pine forest.

Comarum palustre L. (*Potentilla palustris* (L.) Scop.) M 981. Locally abundant in open peat bogs; also found in the outer margins of lake bogs.

Drymocallis arguta Rydb. (*Potentilla arguta* Pursh) T 1246. The only record, occurring in a rich mineral soil of a high outcrop ridge; on a S.-facing slope.

§ *Potentilla pensylvanica* L. T 1251. The only record, found in dry mineral soil on the southern aspect of a high outcrop ridge.

§ *Potentilla pensylvanica* L. T 1251. The only record, found in dry mineral soil on the southern aspect of a high outcrop ridge.

Geum perincisum Rydb. (*G. macrophyllum* Willd. var. *perincisum* (Rydb.) Raup) M 1192. Found in this area only in the ground vegetation of white-birch forest on very local organic ridges.

Rubus chamaemorus L. M 1138a, T 1262a. Common, occurring in the *Sphagnum* mat zone of peat bogs and in muskegs.

Rubus pubescens Raf. M 1121, 1206. Locally common, occurring in the ground vegetation of open pinewoods (seral) and on a few shoreline outcrop communities.

Rubus acaulis Michx. M 984. Occasional, confined to peat bogs where it occurs in *Sphagnum* cushions.

Rubus idaeus L. var. *strigosus* (Michx.) Maxim. M 1118, 1200. Common, occurring in dry habitats of various forest types.

Rosa acicularis Lindl. M 960. Of frequent occurrence in mixed and pure black spruce forests on well-drained mineral substrata.

Prunus pensylvanica L. T 1248. The only record, growing on the southern aspect of a high greenstone ridge in well developed mineral soil.

§ *Oxytropis splendens* Dougl. T 1241. Rare, occurring on crevice habitats of a high greenstone ridge of southern aspect.

Geranium bicknellii Britt. T 1256. Very local, of weedy habit in a shoreline habitat exposed by recent lowering of the level of Tod Lake.

Callitriche palustris L. M 1078. The only record, found totally immersed at 40 cm., growing with *Myriophyllum exalbescens*.

Empetrum hermaphroditum (Lange) Hagerup M 1055. Confined to the open pine forest community on high granite outcrops where it is locally frequent.

Viola palustris L. M 1150. Local, found in slightly silted peat bogs and lake bogs.

Shepherdia canadensis (L.) Nutt. M 1225, T 1239. The only localities in the region, in both cases it occurred on well-drained slopes of southern exposure growing with white spruce.

Chamaenerion angustifolium (L.) Scop. (*Epilobium angustifolium* L.) M 1028, 1030, T 1283. Scattered throughout the mixed (seral) forest types on mineral substrata, extending into the spruce muskeg.

Epilobium palustre L. M 973, 1091, 1144. Common, found in wet peaty habitats with some mineral matter — such as muskeg streams and lake bogs.

Epilobium davuricum Fisch. M 1182. Local, found only in peat bogs growing in a cushion of *Sphagnum fuscum* with *Aulacomnium palustre*.

Epilobum glandulosum Lehm. var. *adenocaulon* (Haussk.) Fern. M 1097, 1196. T 1288. Locally common in humous substrata at pond and lake margins.

Myriophyllum exalbescens Fern. M 1077. Occasional in shallow shoreline waters at ½ - 1 m. depth.

Hippuris vulgaris L. M 1110. Common in shallow ponds and lake margins, often associated with *Utricularia vulgaris*.

Aralia nudicaulis L. M 1223. Confined to shaded, well-drained loamy soils, most commonly found on steep spruce-clad slopes.

Cicuta mackenzieana Raup M 1146. Occasional, found in peat bogs which give evidence of local silting.

Sium suave Walt. M 1035. Common, growing in shallow water of lakeshores, ponds and small rivers.

Chamaepericlymenum canadensis (L.) Aschers. & Graebn. (*Cornus canadensis* L.) M 947. Locally common on well-drained slopes in the closed pure and mixed spruce forest types.

Cornus stolonifera Michx. M 1082, T 1301. Of local occurrence, found along lake shorelines with willows and on stream banks with rich alluvial soil.

Ramischia secunda (L.) Garcke M 1006, 1140. Of local occurrence, confined to bogs and muskegs where it grows in the cushions of *Sphagnum*, generally *S. fuscum*.

Pyrola asarifolia Michx. M 1065. Confined to shaded, mossy sites in closed spruce forest types where it forms local clones.

Ledum groenlandicum Oeder M 932. The most common shrub, it is found in all but the wettest and driest habitats, in both open and shaded locations and on both mineral and organic substrata.

Kalmia polifolia Wang. M 967. Infrequent, it is found only in the transitional zone between peat bogs and spruce muskeg, usually growing in a cushion of *Sphagnum*.

Andromeda polifolia L. M 966, 1021a. A bog plant, it forms conspicuous societies with various sedges and *Oxycoccus microcarpus* on the summits of large *Sphagnum* cushions.

Chamaedaphne calyculata (L.) Moench var. *angustifolia* (Ait.) Rehd. M 1013. In certain peat bogs this shrub dominates a broad inner zone, while in others it is not common; it occurs in spruce muskegs.

Arctostaphylos uva-ursi (L.) Spreng. var. *adenotricha* Fern. & MacBr. M 959, 1127. Locally abundant, it is found in dry, often mineral soil of open areas in the spruce forest and (more commonly) in open, subseral pine forests.

Arctous rubra (Rehd. & Wils.) Nakai (*Arctostaphylos rubra* (Rehd. & Wils.) Fern.) M 991. Very local, it occurs in spruce muskegs, extending into damp, mossy situations in the closed spruce forest.

Vaccinium uliginosum L. M 946. Confined to the same habitats as the last species.

Vaccinium myrtilloides Michx. M 1046, T 1271. Common in open pinewoods on granite outcrop ridges.

Vaccinium vitis-idaea L. ssp. *minus* (Lodd.) Hult. M 931. Locally abundant in the closed spruce forest, mixed forest types and spruce muskeg, it also occurs in pine forests on sand plains and outcrop ridges.

Oxycoccus microcarpus Turcz. (*Vaccinium oxycoccus* L.) M 957. Recorded only in peat bogs and muskegs, it is locally frequent, associated with *Andromeda* and *Sphagnum*.

Naumburgia thyrsiflora (L.) DC. (*Lysimachia thyrsiflora* L.) M 1080. Widespread in the area, it is confined to aquatic habitats, growing in 20 - 50 cm. of water at lake and river margins.

Trientalis borealis Raf. T 1297. The only record, growing in humous soil on a southern slope of a ridge dominated by an open stand of white-spruce.

Menyanthes trifoliata L. M 1015. Common in the pioneer zones of marginal lake-bog and peat-bog vegetation.

Mertensia paniculata (Ait.) G. Don M 930. Common, recorded in all forest types on mineral substrata.

Scutellaria epilobiifolia A. Hamilton M 1081. Of local occurrence, growing in humous soil on shoreline outcrops and in the ground vegetation of white-birch stands on organic ridges.

Dracocephalum parviflorum Nutt. T 1305. Rare, of weedy habit, recorded on an open shoreline habitat which has been exposed by a recent drop in the level of Tod Lake.

Lycopus uniflorus Michx. M 1168, 1220. Confined to wet peat, growing in lake-bogs and in shoreline habitats.

Utricularia vulgaris L. M 1195, T 1284. Locally common in shallow peaty water of lake-bogs and ponds.

Pinguicula villosa L. M 1138. Rare, found only in the surface of cushions of *Sphagnum fuscum* in muskegs, usually associated with *Rubus chamaemorus*.

Galium trifidum L. M 1090. In local abundance with *Sphagnum* spp. and *Aulacomnium*

palustre in the wet marginal peat of a pond.

Linnaea borealis L. ssp. *americana* (Rehd.) Hult. M 954. Common in dry, slightly open parts of closed spruce and mixed forest types.

Solidago multiradiata Ait. M 1232. Confined to open sunny habitats in the open seral forests of eskers and dry clay plains, and on exposed outcrops.

§ *Solidago decumbens* Greene var. *oreophila* (Rydb.) Fern. T 1240. The only record, on an exposed, S.-facing outcrop slope, growing in a small crevice.

§ *Aster ciliolatus* Lindl. M 1231. The only record, growing in an open tract of a seral shrub woodland on a small esker.

Erigeron elatus Greene M 1095. Rare, recorded in wet, peaty soil in a mixed spruce-tamarack forest over clay.

Achillea millefolium L. M 1104. On a dry organic ridge flanking a pond; locally common.

§ *Artemisia caudata* Michx. var. *douglasiana* (Besser) Boivin (*A. caudata* of American authors) T 1245. The only record, found in rich mineral soil on the southern slope of a high outcrop ridge, growing in open situations of high insolation.

Petasites palmatus (Ait.) Gray M 939. Common, occurring in various seral types of the closed spruce forest; also it occurs sporadically in muskeg.

Senecio pauperculus Michx. M 1149. Of very local occurrence, recorded in a peat-bog through which a small silt-carrying stream passes.

Senecio pauperculus Michx. var. *flavovirens* (Rydb.) Boivin T 1125. Rare, recorded in an open heathy vegetation associated with subseral pine forest.

Arnica lonchophylla Greene var. *lonchophylla* M 1071. Rare, the only record, growing on a sunny shoreline outcrop.

Hieracium umbellatum L. M 1229. The only record, growing in dry humous soil on an open, outcrop island in MacBride Lake.

BRYOPHYTA

Sphagnum capillaceum (Weiss) Schrank M 945, 992, 1064. The dominant of muskeg ground vegetation, forming dense hummocks; it occurs sporadically in other communities.

Sphagnum fuscum (Schimp.) H. Klinggr. M 994, 997, 998, 1141. Abundant in peat-bogs and muskegs, forming large cushions.

Sphagnum riparium Ångstr. M 1194. Forming a pure mat covering a small depression in a spruce muskeg at MacBride Lake.

Sphagnum squarrosum Crome M 1023. It occurs locally in peat-bogs as a subsidiary hummock builder.

Sphagnum warnstorfianum Du Rietz M 1022. The dominant of the stable mat of mature peat-bogs, forming large hummocks with *S. fuscum*.

Andreaea rupestris Hedw. M 1063, 1170. T 1280. Common on moderately sheltered and open outcrops of rock.

Polytrichum piliferum Hedw. M 1164. Typically it occurs as a colonizer in areas of disturbed substratum, often on the mineral soil which is exposed by uprooted trees.

Polytrichum juniperinum Hedw. var. *alpestre* (Hoppe) BSG. M 940, 1000, 1174. Occurs in a wide range of habitats, usually in peaty, moderately to poorly drained substrata.

Polytrichum formosum Hedw. T 1302. The only record, forming a distinct zone in a low swampy area, associated with *Carex oligosperma* and *Juncus filiformis*.

Polytrichum commune Hedw. M 1044. Locally abundant in damp humus accumulations in hollows of outcrops.

Ditrichum flexicaule (Schwaegr.) Hampe. M 1193. Uncommon, observed only on thin humus over exposed, sunny shoreline outcrops on MacBride Lake.

Ceratodon purpureus (Hedw.) Brid. M 962, 1160. Local in shaded, damp sites in spruce forests, often growing on the bases of spruce trunks.

Dicranum strictum Schleich. M 1167. Local, forming small tussocks in shaded humus at the base of black-spruce trees.

Dicranum fuscescens Turn. M 1156. Occasional in the 'feather-moss' carpet of mature black-spruce forests.

Dicranum rugosum Brid. M 943, 1152. Occasional, locally frequent, in black-spruce forests and related seral types.

Dicranum elongatum Schleich. M 1213. The only record, occurring on a shaded granite outcrop on MacBride Lake shoreline, growing with *Cladonia rangiferina*.

Dicranum bergeri Bland. M 920, 952, 993, 1004, 1161. A close associate of *Picea mariana*, being abundant in spruce forests and muskegs.

Tetraplodon mnioides (Hedw.) BSG. T 1309, Local, growing at the base of black-spruce trunks in a closed forest.

Pohlia nutans (Hedw.) Lindb. M 941, 1162, 1199. Common on dry, often shaded, humous

soils, in spruce and pine forests; occasional in muskegs.

Pohlia sphagnicola (BSG.) Lindl. & Arn. M 999. Locally common, confined to the surface of hummocks of *Sphagnum capillaceum* in spruce muskegs.

Mnium affine Bland. M 112. Common in wet, open peat of bog pools and ponds.

Mnium cinclidioides Hedw. M 1168a. Frequent in shaded, low humous banks of MacBride River, with *Climacium dendroides*.

Mnium sp. M 1184. A new species, to be described shortly by Dr. W. C. Steere. The only record, found in wet peat at the margin of a large open bog.

Meesia triquetra (Hock. & Tayl.) Ångstr. M 1017a, 1019a. Common in the partly submersed moss mat of the outer zone of peat-bogs, associated with *Drepanocladus aduncus*.

Meesia uliginosa Hedw. M 1004a. Infrequent in wet areas of spruce muskegs.

Bryum cuspidatum (BSG) Lindl. & Arn. M 999. Locally common, confined to the thin humous layer over clay in open subseral pine forests.

Climacium dendroides (Hedw.) Web. & Mohr. M 1169. Frequent on shaded, vertical banks at lake and river shorelines.

Hedwigia ciliata (Hedw.) P.B. M 1179. Less common than in southern regions, it forms mats locally on the sloping surfaces of outcrop rocks.

Thuidium abietinum (Brid.) B. & S. M 1207. Infrequent, on damp humus of exposed shoreline outcrops at MacBride Lake.

Drepanocladus aduncus (Hedw.) Warnst. M 1017, 1020, 1111. The dominant moss of the open, colonizing mat of the wetter parts of peat bogs.

Drepanocladus intermedius (Lindb.) Warnst. M 1018, 1019a. Associated with the previous species, it is frequent in peat bogs.

Drepanocladus sendtneri (Schimp.) Warnst. M 1212. Locally abundant in shallow parts of MacBride Lake where it forms a dense community at 30 - 60 cm. in silty lake bottom sites with *Potamogeton robbinsii* and *P. alpinus* var. *tenuifolius*.

Camptothecium nitens (Hedw.) Schimp. (*Tomenthypnum nitens* (Hedw.) Loeske) M 969, 996, 1021, 1026. Abundant in the *Sphagnum-mat* of peat bogs and in spruce muskegs; in both communities it forms dense hummocks.

Eurhynchium diversifolium (Schleich.) B. & S. M 1123. Common in open, subseral pine forests, growing on thin humus over clay with *Peltigera canina* var. *rufescens*.

Brachythecium mildeanum (Schimp.) Milde M 1198. Local, occurring in the ground vegetation of rare white-birch stands on peat ridges.

Pleurozium schreberi (Brid.) Mitt. M 918, 1151. The dominant of the 'feather-moss' layer of closed spruce woods; abundant in subseral mixed forests and in drier parts of muskegs.

Hypnum hamulosum B. & S. M 1085. Very local, forming loose mats on damp, exposed humus of exposed shoreline outcrops.

Ptilium crista-castrensis (Hedw.) De Not. (*Hypnum crista-castrensis* Hedw.) M 921, 1163. A characteristic member of the 'feather-moss' ground vegetation of mature spruce woods, forming discrete, pure stands.

Rhytidium rugosum Brid. M 1222. Locally abundant, confined to well-drained open sites, usually with a southern exposure.

Hylocomium splendens (Hedw.) B. & S. M 926, 1153. A constant and abundant member of the 'feather-moss' carpet of closed black-spruce forests; also found in pine forests and in drier parts of muskeg vegetation.

LICHENES

Nephroma helvetica Ach. T 1259. The only record, found on steep outcrop slopes in dense shade under mature black-spruce forest on a North-facing ridge slope.

Peltigera aphthosa (L.) Willd. M 923. Frequent, often associated with *Pleurozium schreberi* in the ground vegetation of pure and mixed black-spruce forests.

Peltigera aphthosa var. *variolosa* (Mass) Thoms. M 1158a. The only record, found in the moss carpet of a mature black-spruce forest, with *Pleurozium*.

Peltigera canina (L.) Willd. var. *rufescens* (Weis.) Mudd. M 1120. Common on clay soil in open pinewoods.

Peltigera malacea (Ach.) Funck. M 928a, 1158a. Frequent in the ground carpet of mosses in pure and mixed black-spruce forest types.

Cladonia alpestris (L.) Rabh. M 1154. Locally frequent in mature spruce forests where it replaces the moss carpet in areas of improved illumination.

Cladonia coccifera (L.) Willd. M 1172, T 1278. Common in dry, exposed humus of high outcrops and open tracts of subseral pine forests.

Cladonia crispata (Ach.) Flot. var. *virgata* (Ach.) Vainio M 942, 1173, T 1279a. Common on humus of flat outcrop ridge summits and open, lichen covered tracts of open pine forests over clay.

Cladonia deformis Hoffm. T 1277. Occasional in the lichen carpet of unshaded ground in open pine forest types.

Cladonia glauca Flk. M 928a, 995, 1159. Common in pure and mixed stands of black-spruce forests, forming small local tussocks on exposed humus, often at the bases of spruce trunks.

Cladonia gracilis (L.) Willd. M 1197, T 1279. Not infrequent in humous, partially shaded situations of mixed pine-birch stands on clay ridges.

Cladonia mitis Sandst. M 924. Locally common in drier sites of mixed spruce-pine-birch seral forest types on till ridges.

Cladonia rangiferina (L.) Web. M 1155. Locally abundant in incompletely shaded parts of spruce forests, on sheltered outcrops and high outcrop ridge summits.

Stereocaulon paschale (L.) E. Fr. M 925. Occasional in mixed spruce-pine-birch forest types on outcrop ridges.

Actinogyra mühlenbergii (Ach.) Schol. M 1047. Consistently saxicolous, it is locally abundant on large exposed outcrops of ridge summits.

Parmelia centrifuga (L.) Ach. M 1048. Locally dominant on exposed outcrop surfaces, it is characteristic of high ridge pine-dominated communities.

Parmelia olivacea Nyl. M 1202. Epiphytic, common on the bark of *Betula papyrifera* var. *neoalaskana*.

Parmelia stenophylla (Ach.) Hueg. M 1049. Of local occurence on outcrops of high summit ridges.

Parmelia sulcata Tayl. M 1201. Epiphytic, common on the bark of *Betula papyrifera* var. *neoalaskana*.

Cetraria hepatizon (Ach.) Nyl. M 1053, 1171. Occasional, locally frequent on large outcrop rock surfaces of high ridge summits.

Cetraria nivalis (L.) Ach. T 1293. On dry humus over outcrop surfaces, on a relatively high granite ridge; the only locality for the region.

Evernia mesomorpha Nyl. M 1203. Epiphytic on trunks and branches of birch, spruce and pine; common.

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ADDITIONS AND CORRECTIONS — VOLUME 70

Page 78. Under photograph insert legend and credit: Fig. 1. Drummond's Vole (Photograph by R. D. Bird).

Page 99, column 2, line 8 from bottom. **For** 62°7'N. lat., 115°55'W. long. **read** 62°27'47"N. lat., 114°54'W. long.

Page 140, column 2, line 32. For *Acanthus* read *Acanthis*.

Page 141. In the note entitled "Great Gray Owl Near Black Sturgeon Lake, Ontario," the Black Sturgeon Lake intended is some 60 miles north by east of Port Arthur.

THE AMERICAN EGRET IN MANITOBA

RALPH D. BIRD

Science Service, Entomology Division, Canada Department of Agriculture, Brandon, Manitoba

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The year 1955 is noteworthy in that the American Egret *Casmerodius albus egretta* (Gmelin) was recorded for the first time as nesting in southeastern Saskatchewan and in southwestern Manitoba. Fox (1955) records a pair of egrets nesting and raising three young in the Qu'Appelle Valley north of Regina, Sask. Oeming and Riggall (1955) record the egret as being first seen in Alberta in 1954 at Cowley and Edmonton. I was privileged to find a pair of egrets nesting near Pipestone, Man. It is hence appropriate to draw together at this time all scattered records of this bird in Manitoba.

R. W. Sutton, Director of the Manitoba Museum, has supplied early records from his files. An American Egret was shot at Duck Bay, Lake Winnipegosis, in 1888 by David Armit. Another was shot by an Indian on the Wanipigow River, Manigotagan, Man., in 1930. In 1953 one American Egret spent a month on a slough near Lockport. In the same year, and again in 1954, Albert Hochbaum observed an egret fly past the Delta Waterfowl Research Station, Delta, Man., in May.

On May 10, 1955, I observed an American Egret feeding in flooded flats of the Souris River at Napinka, Man. When first seen it was only fifty yards from the road grade along which I was driving. I stopped and watched it with a pair of 6× binoculars. The black legs and yellow bill, with some black markings indicating it was last year's juvenile, were plainly visible. It then became alarmed and flew another fifty yards in the marsh and was observed to stalk and capture a large frog, which it grabbed by the middle. After much shaking and pounding, the frog was turned around and swallowed head first. The swelling could be distinctly seen as the frog went down the bird's neck, after which the egret with its beak upright 'smacked its chops' with evident satisfaction.

On June 5 for the purpose of photography, I visited a large colony of Great Blue and Black-crowned Night Herons nesting in some boxelder trees on an island in a marsh twelve miles north of Napinka. To my surprise and delight, an egret was found associated with the herons and obligingly sat on a tree within twenty yards of my blind near the top of an adjacent tree. I was able to secure some excellent shots in both color and black-and-white with an Exakta camera and 300-mm telephoto. The bird was much troubled by a swarm of black flies *Simulium* sp. and spent considerable time rubbing its neck with its bill and scratching with its foot. The herons accepted it as a member of the colony and did not molest it in any way.



American Egret at Pipestone, Manitoba
(Photograph by author)

On returning to the colony on June 19, I found the egret frequenting the same tree. Its nest, well hidden on the end of a leafy

branch, was in an inaccessible spot about fifteen feet above the ground, but I was able to see the heads of at least two downy young. The mate was observed several times in flight but was quite wary and did not approach closer than fifty yards. More photographs were taken.

Later, Mrs. James Stewart of Napinka wrote to say that on August 12 she saw four snow-white birds perched on trees in a swampy location along the Souris River. She approached quite close and gave a very good description of the birds, which were undoubtedly American Egrets. She described three of the four as young because they had "little tail as yet." Later she approached to within twenty feet of the birds on a sand bar and again noted that the young did not have the "fluffy tail" of the adult.

This group of birds was probably the family I had observed nesting in the swamp twelve miles north, and their presence indicated that three young had been successfully raised.

The heron colony was visited in 1953 and 1954. In neither of these years were egrets observed.

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[Editor's note : Since acceptance of this article the author has informed me that no egrets were seen in 1956.]

SEVENTH CENSUS OF NONPASSERINE BIRDS IN THE BIRD SANCTUARIES OF THE NORTH SHORE OF THE GULF OF ST. LAWRENCE

LOUIS LEMIEUX

Canadian Wildlife Service, Quebec, Quebec

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The seventh quinquennial census of nonpasserine birds in the bird sanctuaries of the north shore of the Gulf of St. Lawrence was conducted from June 2 to June 21, 1955. Travel was with the Royal Canadian Mounted Police ship *MacBrien*, from Rimouski to Blanc Sablon and return. The kind co-operation of the *MacBrien* crew and the fine weather enjoyed throughout the trip made it possible to complete the census in so short a period. The author was ably assisted by Raymond Cayouette, of the Quebec Zoological Garden. The sanctuary caretakers also participated in this census.

The techniques used in taking the census were those described by Dr. H.F. Lewis and followed in the past, except that no estimates were made for birds absent from their nests. It is very difficult to estimate the number of birds away fishing, for instance, since it varies with weather conditions, abundance of food, etc. If the same technician did the work year after year, his estimates might be consistent; however, the census was conducted by different persons in 1945, 1950, and 1955, and it is believed that the estimates may vary considerably on this account. The results for 1955 shown in Table 1 are therefore straight counts. When nests, including those of auks and murres, were counted, their number was, of course, doubled to obtain the number of nesting birds, since only one bird of a pair is on the nest at a time. The 1955 results may thus be interpreted as conservative. It must be further noted that the counts in 1955 were made earlier in the summer than in the past.

A total of 115,700 birds was counted in 1955, an increase of 17 percent over 1950, and of 14 percent over 1945. Three sanctuaries showed decreases since 1950 and the remainder showed increases. Most of the important species were more abundant than in 1950, razor-billed auks having increased by over 100 percent. Eiders were at the 1950 level, still less abundant than in 1945.

TABLE 1. CENSUS OF NONPASSERINE BIRDS IN THE BIRD SANCTURIES

Species	Carrousel Island		Birch Islands		Betchouane		Watshishu		Fog
	1950	1955	1950	1955	1950	1955	1950	1955	1950
Red-throated loon									28
European cormorant									
Double-crested cormorant	164	240					104	270	
Black duck							10	30	6
Pintail									6
Green-winged teal									4
American eider	78	130	1688	1970	1562	1580	1564	430	600
Red-breasted merganser							4	0	2
Semipalmated plover							2	0	10
Spotted sandpiper	2	2	12	26	14	6	12	0	30
Great black-backed gull	2	2	10	54	104	64	114	190	124
Herring gull	800	1450	634	1330	492	724	158	52	124
Ring-billed gull					150	714			0
Kittiwake	600	178			76	120			
Common and Arctic terns			250	176	62	2	420	128	54
Caspian tern									0
Razor-billed auk	38	25			280	444	30	34	22
Common murre									2400
Brunnich's murre									
Black guillemot	148	145	44	20			32	18	108
Puffin					662	232			0
Totals	1832	2172	2638	3576	3402	3896	2450	1152	3518

On Carrousel Island, the bird population was higher than in 1950, lower than in 1945. Kittiwakes have decreased in number substantially, but this is probably due to the fact that many have moved out of the sanctuary to establish new colonies on nearby islands (Manowan and Great Boule). Other species show slight variations.

On Birch Islands, the total number of birds has increased by approximately 30 percent since 1950, and by more than that since 1945. Herring gulls and eiders show the largest increases. Terns were not abundant, but were only beginning to arrive in the sanctuary at the time the count was made.

The Betchouane sanctuary also showed an increase since the last two censuses. Eiders were at the 1950 level, while herring gulls, ring-billed gulls, and kittiwakes had greatly increased. Puffins had decreased. Terns were just beginning to arrive.

The Watshishu sanctuary bird population has decreased by 50 percent since 1950. There is an increasing boat traffic through this sanctuary; 15 boats were seen while we traveled through it. Many fishermen set lobster traps and salmon nets in the sanctuary. The increased human activity probably accounts for the decrease of birds, and it may be expected that the trend will continue. Eiders and herring gulls have decreased substantially in the sanctuary. Terns had not yet started to nest.

An increase was noted in the Fog Island bird population. Ring-billed and great black-backed gulls as well as eiders were more abundant. Murres showed a surprising decrease; they were apparently not all nesting at the time we visited the sanctuary.

A 100 percent increase of the total bird population was recorded at the Wolf Bay sanctuary, puffins and razor-billed auks having increased tremendously. There, too, the season was early for terns. The eider population was higher than in 1950.

Conditions were stable at the St. Mary Islands. The total number of birds was somewhat lower than in 1950; a decrease in

OF THE NORTH SHORE OF THE GULF OF ST. LAWRENCE, 1950 AND 1955

Island	Wolf Bay		St. Mary Islands		Mecatina		St. Augustin		Bradore Bay		Totals	
1955	1950	1955	1950	1955	1950	1955	1950	1955	1950	1955	1950	1955
24	10	4	20	16	30	24	16	14			104	82
			490	678							490	678
	164	180	0	14	0	26					432	730
8			2	1	0	2	4	20			22	61
2			2	0							8	2
0			2	2							6	2
910	720	1126	600	1450	750	142	1100	950			8662	8688
0	0	30					6	0	0	6	12	36
0			2	1	4	0			12	4	30	5
24	6	12	12	16	14	8	16	2	12	16	130	112
268	228	248	106	748	150	56	160	90	0	4	998	1724
66	396	364	670	1032	548	276	860	1184	0	4	4682	6492
1762					30	0	0	314			200	2790
											676	298
82	8	44	0	8			0	10			794	450
76											0	76
50	2200	8030	3800	3906	144	0			1760	6000	8274	18489
670	2180	2054	6862	7070					180	2500	11622	12294
			2	0							2	0
126	6	100	326	312	600	200	182	70			1446	991
2	5600	9670	5400	2538					48622	49258	60284	61700
4070	11518	21862	18296	17792	2290	734	2344	2654	50586	57792	98874	115700

the puffin population is responsible for this. Eiders were more abundant than in 1950, and so were most other species. Brunnich's murres were not seen at the time of the census, but the caretaker has since reported observing one of these birds. The European cormorant colony has increased substantially. St. Mary and Fog Islands are no doubt the most interesting sanctuaries along the coast because so many different species nest there.

The Mecatina sanctuary was blocked with ice in the spring, and this may account for the great decrease of the bird population there. Black guillemots, razor-billed auks, herring gulls, great black-backed gulls, and eiders were less abundant than in 1950.

Not much change was observed at St. Augustin Islands; herring gulls had increased while eiders showed a slight decrease. The black guillemot and black-backed gull populations were low.

At Bradore Bay, auks and murres had greatly increased, while puffins were slightly more plentiful. Other species were present in insignificant numbers. The total bird population of this sanctuary had increased substantially.

As may be seen, conditions were generally very good in 1955 in the north shore bird sanctuaries.

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REVIEWS

Annual Report for 1955 of the Denver Museum of Natural History

Denver, Colo., 1956. 70 p.

This finely printed and illustrated booklet demonstrates the rapid growth and development of the Denver Museum. Included are photographs of twenty-nine habitat groups and murals that appear to be of excellent quality. Several of the groups illustrated are of prime interest to Canadian naturalists. The Museum is to be congratulated both for this attractive report and for the achievement that it represents.

D. B. O. SAVILE

The Last Passenger

By JAMES RALPH JOHNSON, New York, The Macmillan Company and Toronto, Brett-Macmillan Ltd. 1956. 10 pen drawings, 116 p. $2.75.

The story of the last of a wildlife species is ever one of nostalgia and regret but the tragedy lies only in the ruthless role played by man in its disappearance without return. In this little book the author offers the life history of Blue, the last passenger pigeon, and he selected this theme for the sentient reason that he could not bear the thought of the last survivor of a famous species living out its life in a zoo, but envisioned it as a feed bird winging its own way into oblivion. In light sketches he draws the biological background of the passengers, revealing to those who may not know some of the important factors which, apart from man's merciless slaughtering, in time perhaps inevitably would have brought about the extinction of a species once so impressively alive.

There is a lack of good timing in that it seems impossible to compress the period lasting from the flocks of thousands "darkening the skies" to the existence of but one survivor within the short life span of a single bird, in the opinion of this reviewer an all too ultrarapid reduction, and in this an opportunity for subtle dramatization has perhaps been overlooked. Despite anthropomorphic lapses, admittedly difficult to avoid in a biographical sketch of this kind, and a now obsolete theory on bird migration, the appeal of Blue is poignant, less so through the literary ability of the author than through the very fact that the gentle bird must have existed. When writing of weather and flight in particular, the author nevertheless presents us passages of much poetic beauty and understanding because, being an airman in the United States Air Force, he knows these things intimately and has a profound feeling for them. His greatest artistic contribution Mr. Johnson undoubtedly makes by his own exquisite pen drawings which illustrate the book. His audacity of design recalls Audubon's folios but he works it beyond the mere figures of the wildlife into their backgrounds with fine artistry. This alone should secure the book a space on the book shelf of every discerning nature lover.

LOUISE DE KIRILINE LAWRENCE

The Great Migrations

By GEORGES BLOND. New York, The Macmillan Company and Toronto, Brett-Macmillan Ltd., 1956. 192 p. $4.00.

This interesting book, which will delight the layman and occasionally inform the expert, deals with half a dozen of the world's most spectacular animal mass-movements. Whether these journeys are all migrations in the dictionary meaning of that word is immaterial since they are all dramatic, arresting, intensely interesting, not yet fully explained and of great importance to man. Once started, the book will not easily be laid aside.

The author has made skillful use of the device of anthropomorphism, in a way that adds much to the presentation of the biological data.

The migrations chosen are of great interest. The biological facts may be a little overshadowed, in some cases, by the dramatic form of presentation.

The author has secured his scientific facts and interpretations from experts in the field. He has mentioned his advisers but, as might be expected in a book written primarily for the layman, has not included a bibliography of titles or other exact references to published literature in the fields covered.

Five of the six examples chosen are from the old world but references to research and the choice of a North American species, the North American bison for one example, indicate the breadth of the author's research in preparation for the writing of the book.

The use of old-world examples is particu-

larly interesting in a book readily available to a North American audience because it indicates the universality of the phenomena described and the impact of North American research results on the development of European theories. Several points of view are presented for each controversial matter in the well-rounded and interesting discussions.

The spectacular and hazardous migration of the Asiatic Graylag geese, at first on foot and then in flight at high altitude over the major mountain barriers of Asia, is well described.

The carefully detailed description of Atlantic salmon migration from freshwater hatching through marine growth to freshwater spawning is well done according to classical information. Recent United States and Canadian work on chemical sensitivity as guides to spawning streams, however, is not mentioned.

The history of the unfolding of the facts of the migration of the eel and its study over a period of 2300 years is given all its beautiful simplicity and amazing complexity.

The story of the extirpation of the plains bison from the majority of its North American range includes a wealth of historical detail, much of which is of no credit to the authorities of the time during which the major destruction occurred.

The full horror and appalling beauty of the locust plagues in Africa, of their devastation of crops and of modern methods which are now bringing them under control and reducing the agricultural loss, are described in vivid detail. The idea of a cloud of pink locusts covering an area of 90 square miles is difficult to grasp, but the author manages to convey a large measure of understanding through his dramatic treatment.

The build-up of lemming populations, the stresses and endoctrine upset, the persistence of the long and difficult migration are, for greater effect, presented as if seen through the eyes of one of the lemmings. The lemming story, as carefully based on up-to-date scientific evidence as all the others, illustrates again the versatility of the author and his ability to transmit vivid impressions and general biological principles to the reader.

The book has been translated from the French into smooth-flowing English by Francis Frenaye. The type is easy to read and free from typographical errors.

V. E. F. SOLMAN

The Singing Wilderness

By SIGURD F. OLSON. New York, Alfred A. Knopf, 1956. 38 illustrations by Francis Lee Jaques, 245 p. $4.00.

No one who has traveled in the wilderness or toted a canoe over a portage or paddled down a quiet lake can fail to find a responsive chord in this book. Not a natural history book in the sense that it provides facts or seeks to instruct the reader in nature lore, it is rather an interpretation of the deep emotions aroused by close association with the wilderness and the creatures living there.

In a series of short essays describing various experiences in the Quetico-Superior country, the author expresses in beautifully written, at times almost lyrical, prose the feelings and emotions aroused by his personal contacts with the sights, sounds, and smells of nature. The essays are unrelated except that they are loosely grouped to follow the march of the seasons from spring to winter.

It is the simple things that appeal to him: the early signs of spring, a squirrel gathering pine cones, a simple country church service, the call of the loon, collecting pine knots for the fireplace in winter, a lonely trapper's cabin, and simply the silence of the woods.

The one theme that binds together all these seemingly unrelated incidents is the need of mankind for the wild places and the necessity of preserving areas of wilderness in their natural conditions, and of conserving not only the game animals as a meat supply but also the predators and all forms of wildlife in a balanced community of nature.

The book is beautifully and tastefully illustrated with black and white drawings by Francis Lee Jaques.

J. WALTON GROVES

The Mammals of Minnesota

By HARVEY L. GUNDERSON and JAMES R. BEER. Minneapolis, The University of Minnesota Press. (Minnesota Museum of Natural History Occasional Papers: Number 6). 26 photographs, 66 distributional maps, 190 p. 1953.

Although this booklet is restricted to Minnesota, it should find ready acceptance among Canadians living in the prairie provinces. Each species recorded in the state within historic times is treated, with range maps on which are plotted specimen and sight records. The short account devoted to each species contains a brief description of the mammal and comments on habits and life history. There are good photographs of a

number of species. More advanced students will find the keys to species useful; these are grouped according to order.

The introductory chapter, dealing with the techniques of study skin preparation, is very good and will be of wide general interest. The accompanying photographs, showing the various steps in the procedure, will be welcomed by the beginner. The sections devoted to trapping methods and specimen label data will also be most useful for the amateur interested in building up a collection of his own.

Both the authors and the publisher are to be complimented on the excellence of this small volume.

AUSTIN W. CAMERON

Theophrastus on Stones

By EARLE R. CALEY and JOHN F. C. RICHARDS. The Ohio State University, Graduate School Monographs, Contrib. in Phys. Sci., No. 1. 238 p., 1956. $6.00.

Twentieth-century geologists, on the whole, have been much more interested in developing the theoretical and practical aspects of their science than in studying its early development. The late Frank D. Adams was one of the exceptions to this rule and we owe him a debt of gratitude for his excellent *Birth and Development of the Geological Sciences* (1938) now again available as a Dover reprint. Interest in the history of geology seems to be growing at present, as shown by the list of reprints and translations which give us an insight into the ancient and medieval knowledge of our science.

Professors Caley and Richards have just published still another such work, important because of its antiquity, a thoroughly scholarly edition of the Greek text of Theophrastus' *On Stones* with an accurate translation and commentary. They are particularly well-fitted for their task; Professor Richards is a Greek scholar of high reputation and Professor Caley a chemist with specialized knowledge of classical archeology, mineralogy, and geology.

This book is highly recommended to all geologists interested in the early beginnings of their science. In fact, it is fascinating reading for anyone with an interest in geology, mineralogy, or chemistry, for here are the first faltering footsteps in these sciences, still encumbered with myth and fancy, but nevertheless revealing penetrating insight into the nature of rocks and their origin and much less fanciful than some of the lapidaries of the Middle Ages.

The Ohio State University Graduate School has spared neither pains nor expense to produce a book of fine scholarship and pleasing appearance, which will be a cherished addition to any geologist's library.

AURÈLE LA ROCQUE

JUN 18 1957
HARVARD UNIVERSITY

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